



Rampion Offshore Wind Farm



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Final Report for



Black Bream in the Eastern English Channel off the Sussex Coast



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1 INTRODUCTION

Following successful award of exclusive development rights for Zone 6 (Rampion), EoN Climate & Renewables UK, Rampion Offshore Wind Limited has commissioned a series of technical investigative environmental studies to inform the EIA and to support the application for a Development Consent Order.

A key consideration of the EIA is the potential effects of the proposals on local critical fish habitats including benthic spawning habitat of local and commercially important black bream *Spondyliosoma cantharus*, as identified in the associated scoping report (RSK Ltd., 2010). These fish arrive on the south coast in the early spring and construct nests on the seafloor into which eggs are laid. This inshore migration and demersal spawning behaviour in the vicinity of the current wind farm proposals means that these fish may be potentially exposed to the effects of construction, operation and decommissioning of the wind farm.

1.1 Purpose

In recognition of this, this document reviews current understanding of the spatial and temporal distributions of black bream and their local behaviour. Any gaps in current understanding are identified and remedial actions are recommended in terms of additional site investigative work to further inform the current EIA.

2 BACKGROUND OF THE STUDY

The commercial and ecological importance of black bream is reflected in the scoping report for the Rampion Round 3 offshore wind farm (RSK, 2010); and were recognised as species of potential sensitivity to the development. In light of this, this report considers the inshore area pertaining to Zone 6 of the Round 3 offshore windfarms (Rampion), between Bognor and Worthing, as likely to encompass an area utilised by black bream for nesting and spawning.

A benthic ecological characterisation survey of the wind farm site has been previously undertaken by EMU Limited (EMU, 2011a). The primary focus of the survey was to record seabed conditions and communities relating to the wind farm development. This incorporated an investigation into the areas of seabed sensitivity i.e. black bream nesting grounds, as specified in the scoping report and identified in the Rampion Offshore Wind Farm Definitive Geophysical Survey (Osiris, 2010). Findings from the benthic ecology survey indicated the site to be dominated by gravelly sand habitats, with shallower coastal regions in the area of the predicted cable route showing a thin layer of sandy gravel and sand habitats over chalk bedrock (James *et al.*, 2010), providing the ideal black bream nesting substrata (Balanced Seas, 2011; Vause and Clark, 2011). An earlier side scan sonar and swath bathymetry survey (Osiris, 2010) tentatively identified three bream nesting sites within the proposed export cable route. However, drop down video surveys undertaken as part of the benthic survey were unable to confirm their presence (EMU, 2011a).

2.1 Effects of installation and operation

Potential impacts from offshore wind farms will occur at different stages of development (construction, operation and decommissioning) causing alteration to the physical environment due to noise, electromagnetic fields, water clarity, disturbance to the substrata and alteration to the hydrodynamic environment. These impacts can be categorised as either having a direct or indirect effect on the physical environment and/or biology of the fish community.

The site of the Rampion wind turbines are located offshore of identified black bream spawning areas and so the placement of turbine foundations are unlikely to directly impact on this critical fish habitat. The most significant construction effect is likely to be underwater noise arising from piling activities. Depending on a number of physical variables (depth and substrate) sound from piling will propagate outward potentially causing severe adverse effects to local and regional fish communities. There may also be a number of associated direct effects relating to the operation of a wind farm. These are primarily related to the migration and movement of local and regional fish communities. Physical barriers through the placement of turbines or interference barriers generated by electromagnetic fields (EMF) from subsea power cables may potentially alter fish passage through the area.

Further potential effects relate to the dispersion and re-distribution of fine sediments distributed by the construction activities via the prevailing currents (Cefas, 2004). These have the ability to extend into the water column affecting pelagic fish and larvae, especially during construction and decommissioning as sediment plumes may increase turbidity or lead to the re-mobilisation of sediment-bound contaminants (Wilson *et al.*, 2010). Sediment dispersal may also form a smothering layer over host substrates some distance from the source. Species who spawn over gravel substrates may temporarily lose viable spawning ground. In turn the fish assemblages of the area surrounding the development may change, giving rise to a wider potential shift in community structure.

3 ECOLOGY OF THE BLACK BREAM

Black bream ([Figure 3.1](#)~~Figure 3.1~~) belong to the *Sparidae* family; the species is a very common inhabitant of northern European waters (Maitland and Herdson, 2006); its northern nesting limit is believed to be the eastern English Channel. As summer migrants, adults are also found in the North Sea (Maitland and Herdson, 2006).



Figure 3.1 Black bream (*Spondyliosoma cantharus*) (©Matt Davison)

Pawson (1995), as well as other reports (see literature within Vanse and Clarke, 2011), described the species as being protandrous, which means that individuals mature as males to later become females. However, recent research suggests this species is protogynous, which means that individuals mature as females (at a length of around 20cm) and then change into males (when about 30-40 cm in length) (Vanse and Clarke, 2011).

This species seems to have become more common in the English Channel since 1951 as earlier records are very limited (Wilson, 1958).

3.1 Reproductive Biology

Black bream are demersal spawners (Pawson, 1995; Vanse and Clarke, 2011). From earlier in the year (when water temperature is between 8-10°C) large males start making nests which may be small. Later, when the spawning season approaches they will enlarge them up to about 1m diameter (Wilson, 1958). Spawning takes place when water temperature is between 12-14°C in captivity (Wilson, 1958). Off the coast of Portugal spawning has been observed in the field with a water temperature range between 14.1°C and 15.4°C. During that study it was observed that spawning was taking place between February and April with a single peak in March (Gonçalves and Erzini, 2000).

Differently to other sparid species, whose eggs are pelagic, this demersal spawner seeks specific grounds for laying the eggs (Sussex IFCA, 2011). Substrate types identified include open gravel areas, gravel areas adjacent to chalk reefs, sandstone reefs and ship's wreckage (Vanse and Clarke, 2011 and literature within). [Figure 3.2](#)~~Figure 3.2~~ shows a typical black bream nest on exposed chalk bedrock off the Sussex Coast.

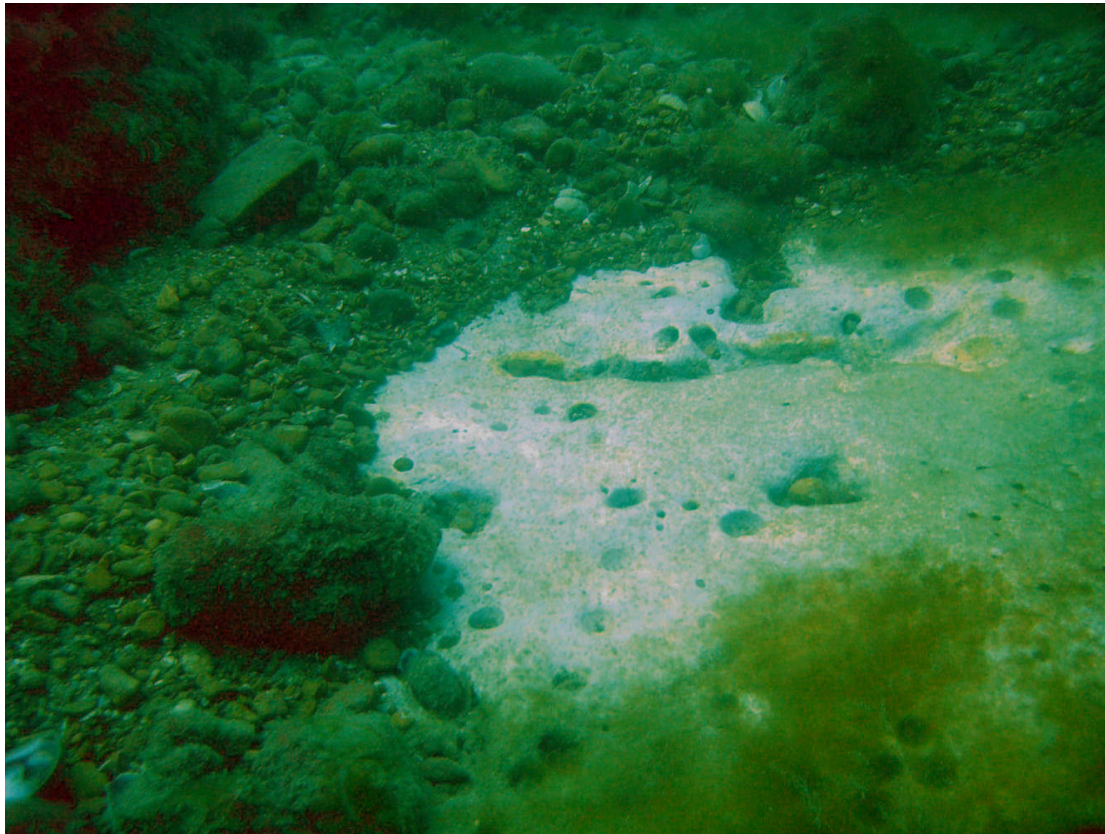


Figure 3.2. Exposed chalk based black bream nest off the Sussex coast. ©Alex Holmes

After fertilizing the eggs, males remain in close proximity to the nests protecting them from predators and keeping the nests clean from excessive siltation ([Figure 3.3](#)~~Figure 3.3~~). After hatching, the first juvenile stage remains in the vicinity of the nests until they reach a length of 7-8 cm (Sussex IFCA, 2011). The mechanism which guides this behaviour is poorly understood¹. Then they move inshore to feed, remaining in the wider area around the nests until maturity (2-3 years) (Sussex IFCA, 2011).

¹ Garrido *et al.* (2009) during their study off the coast of Portugal observed active vertical migrations. The fish larvae observed included larvae of black bream; these were observed concentrating into the neuston (the very top layer of the water column) during the night and throughout the entire water column during the day. This was suggested to enable them to stay longer in more productive areas.

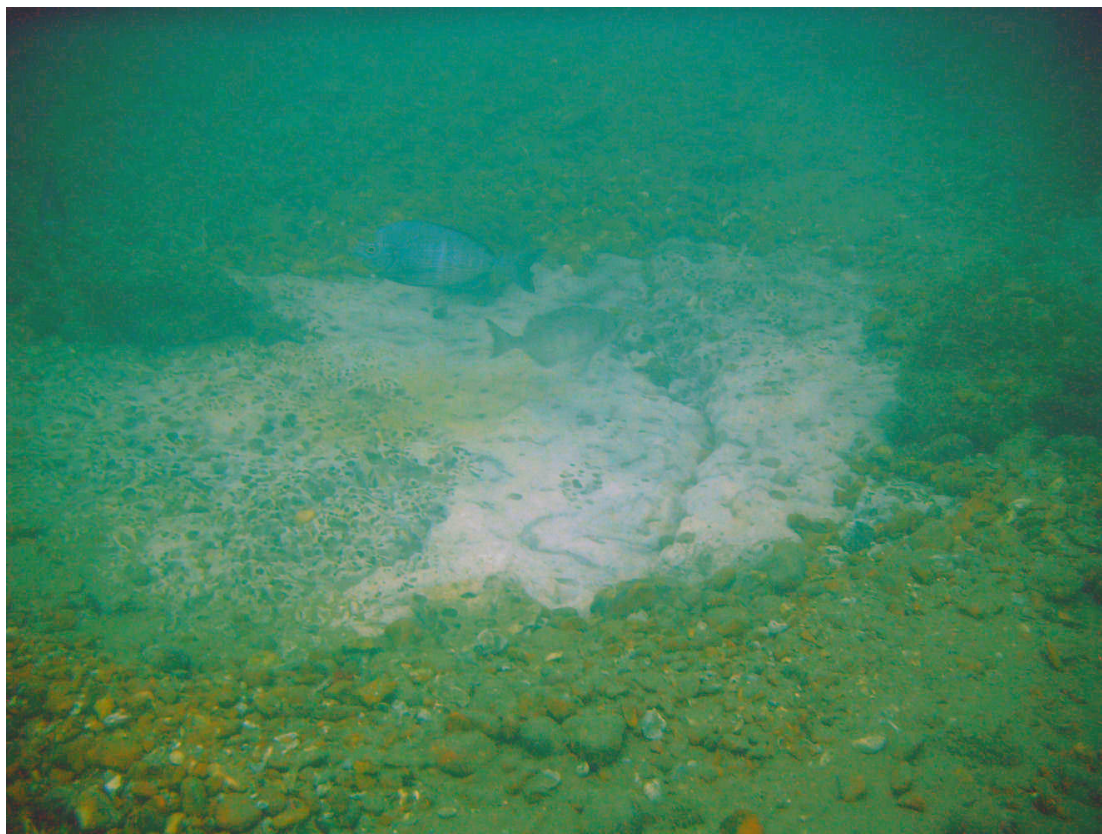


Figure 3.3. Male black bream patrolling the nest. ©Alex Holmes

3.2 Spatial and Temporal distribution in the English Channel

The stock which occupies the English Channel overwinters in water depths between 50-100m, prior to migrating inshore to breed between May and June in suitable habitats (Sussex IFCA, 2011). These include inshore areas around the Isle of Wight, the Solent (Vanse and Clarke, 2011) and the Sussex Coast (Pawson, 1995, Vanse and Clarke, 2011).

During their migrations eastward along the English Channel, it has been suggested that they follow the isotherm of 9°C (Pawson, 1995).

Following the English Channel mean temperature over the past 10 years ([Figure 3.4](#) ~~Figure 3.4~~), and according to the literature, they arrive off the coast of Sussex in the eastern English Channel around March and stay within the inshore areas to feed until April. Egg laying in the area occurs from early May until June (Vanse and Clarke, 2011) when the temperature range is between 13°C and 16°C.

In the western English Channel early laying was observed in 1957 (17th April) as the water temperature was 13°C (about 2°C above the usual temperature for the month) (Wilson, 1958). This suggests the likely relationship of this species' spawning behaviour with the temperature.

The westward migration from these areas starts in November; high concentrations of black bream are observed in January in the western English Channel while on their way to deeper waters (Pawson, 1995).

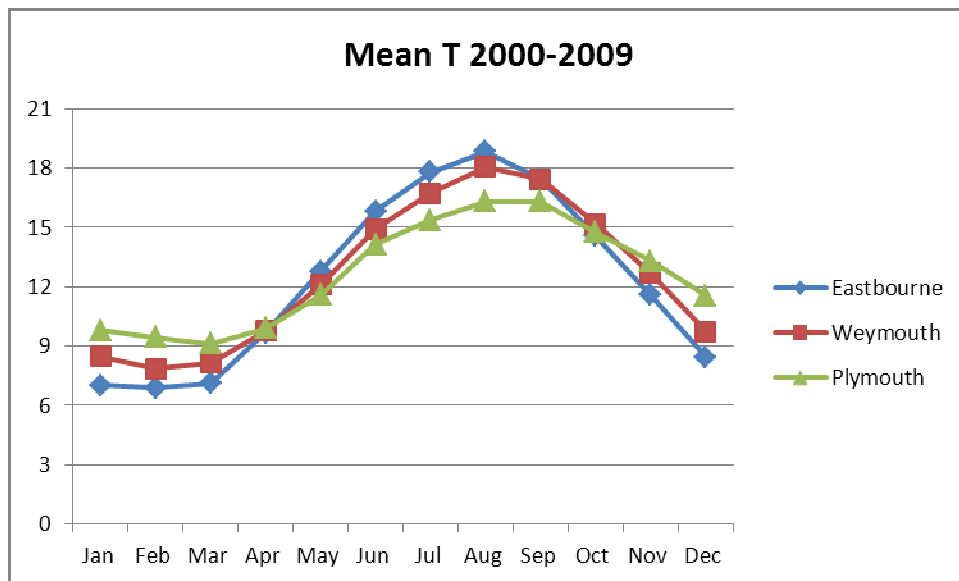


Figure 3.4 Mean surface temperature (SST within the first 5m) recorded at three different locations along the English Channel. From the west (Plymouth) to the east (Eastbourne), including the area of concern.

3.3 Temporal and spatial distribution of black bream off the Sussex Coast

Black bream arrive off the coast of Sussex around March and stay within the inshore areas to feed until April. (Vanse and Clarke, 2011). Commercial landings from the area confirm their presence at this time.

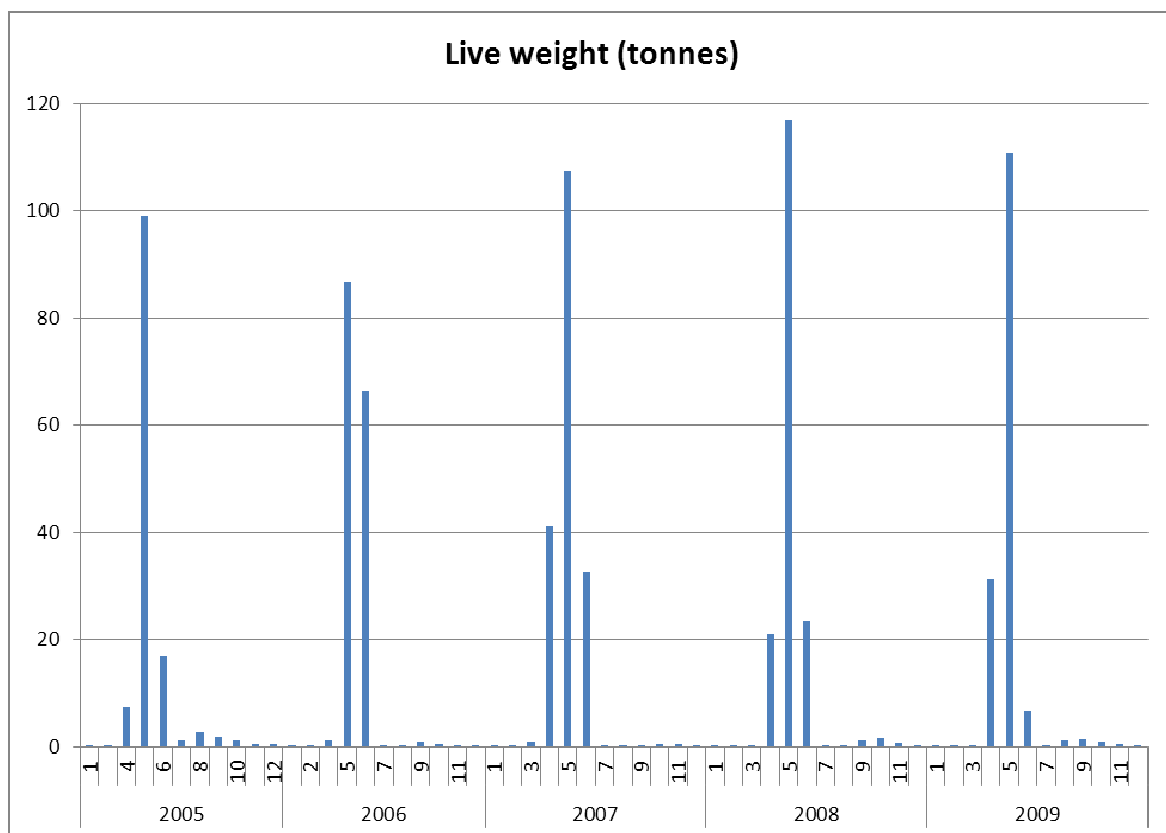


Figure 3.5 Temporal (monthly) distribution of catches in the Rampion Area (ICES 30E9)

Most recent and available data on the distribution of black bream nests off the Sussex coast in the area around the Rampion wind farm development is shown in [Figure 3.6](#)~~Figure 3-6~~. Data presented include EMU Ltd. (2011) and South Coast Regional Environmental Characterisation (SC REC) (James *et al.*, 2007).

Monitoring of black bream nest areas has been undertaken since 1995 to assess potential sediment effects of aggregate extraction on local spawning sites. Initial monitoring was conducted in 1995 (Southern Science, 1995) with monitoring surveys conducted between 2002 and 2011 (EMU Ltd, 2007, 2008, 2009 and 2011b). The monitoring surveys involved drop down video, multibeam echosounders and dual frequency sidescan sonars to identify, classify and map the nesting areas in terms of relative nest densities. In each case, monitoring surveys were conducted in early May to coincide with what is thought to be the onset of peak nesting activity.

Figure 3.5 presents nesting areas in the vicinity of Rampion development and include three black bream nest areas (Areas 1, 6 and 9) which formed part of the aggregate monitoring programme.

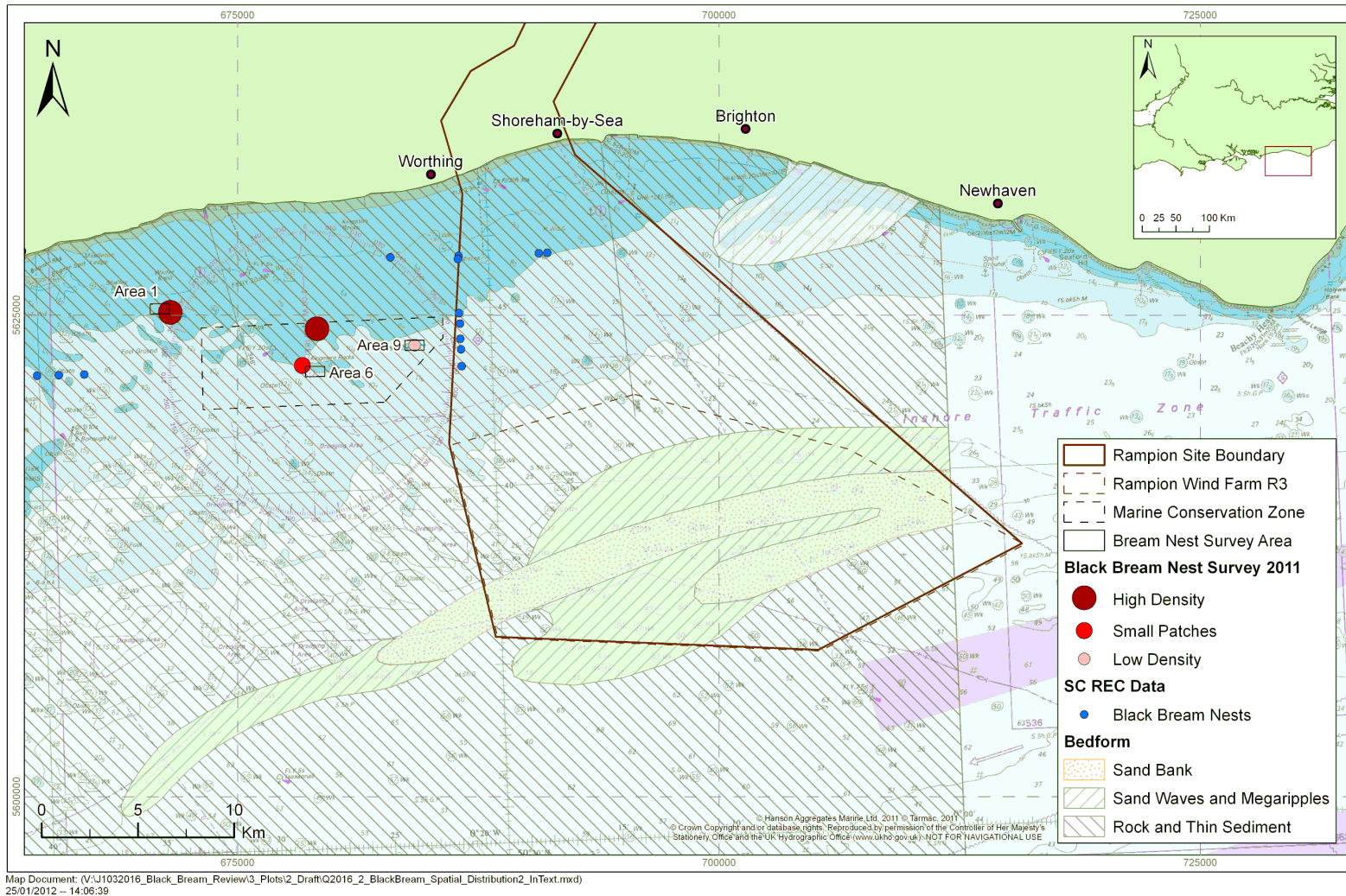


Figure 3.6 Distribution of the known nesting grounds off the Sussex coast in the vicinity and within Rampion (Zone 6 of R3 wind farm development).

Interannual density variations are shown in Figure 3.7. Since monitoring began in 1995, Area 1 has been found to exhibit the highest densities of nests, with an associated annual increase in spatial distribution. However the 2008 dataset showed decrease in nest density with a subsequent recovery seen in 2009. Similarly, the Area 6 dataset recorded a reduction in nest density between 2008 and 2011 in the northern half of the area. This was balanced by an increase in nest concentration across the central band of the site corresponding to the 2002, 2006 and 2007 datasets. Area 9 historically identified nests along a linear chalk outcrop as well as in a linear patch to the south of the outcrop. The 2008 data exhibited no evidence of nests in the area. However, significant patches of nests covering a larger area than identified in historical datasets were observed in the 2009 data set.

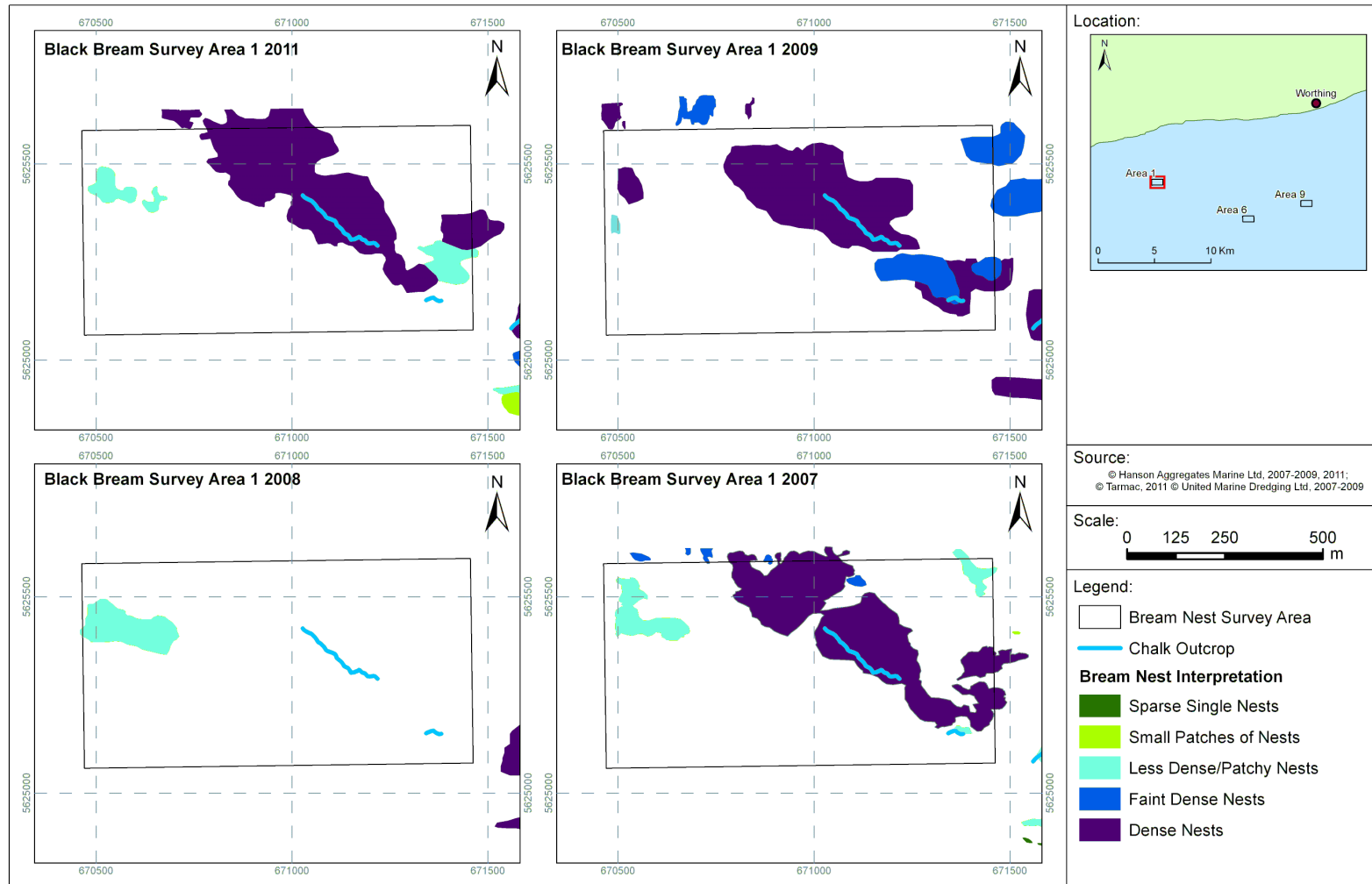
The aggregate monitoring surveys found no evidence to suggest that changes in nest distribution and concentration were attributed to sediment effects and it therefore appears that density of nests fluctuate naturally from year to year.

The most important sites for black bream, corresponding to the highest densities of nests, were found to correlate with the preferred habitat type for the construction of nests, represented by the shallow waters (less than 10 m), a thin layer of coarse sediment (10 to 30 cm deep) overlying bedrock and generally within the vicinity of rocky outcrops. Diver surveys performed in 1995 (Southern Science, 1995) found the shallowest and highest nest density areas were located in the west (Area 1, see [Figure 3.6](#)), where depths ranged from approximately 4.5 m to 10 m. As depth increased to the south and east, corresponding to Areas 6 and 9 respectively (see [Figure 3.6](#)), nest density decreased. No black bream nests were located in deeper waters, generally ranging between 10 m to 20 m. Areas 6 and 9 fall within the proposed Kingmere Marine Conservation Zone (see [Figure 3.6](#)).

During the South Coast Regional Environmental Characterization study black bream nests were recorded within the proposed Rampion Round 3 development area (James *et al.*, 2010). Sidescan sonar records identified black bream nests along the western proposed cable route, suggesting the presence of a more westerly nesting ground (see [Figure 3.6](#)). A sparse distribution of nests were also recorded in between the two proposed cable routes, however, field data for this area and further east (where suitable habitat is present) is lacking.

The apparent absence of nests during the benthic characterisation survey may be a result of the nests previously found being inactive at the time of the survey or perhaps for that year.

Notwithstanding the data with respect to nest distribution it is worth noting that the Southern Science (1995) study indicated that not all nests created are exploited, i.e. eggs are not laid within them. The report suggested that nesting success was related to the nests' size and competition between males at making the largest nests. Males able to make nests over a certain size are probably more likely to attract females.



Map Document: (V:\J1032016_Black_Bream_Review\3_Plots\2_Draft\Q2016_2_BlackBream_Spatial_Temporal_Comparison_Area1_InText.mxd)
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Figure 3.7 Variation in the density of the nests in the period 2007-2011 in Area 1 off the Sussex Coast (Data sources: EMU Ltd. 2007-2011)

4 SENSITIVITY OF THE SPECIES

Below are reported the main threats to black bream in the area of the Rampion R3 wind energy development. Due to its local commercial importance, biology and need for specific spawning habitats, these potential impacts include, amongst others, fishing, aggregate dredging, as well as marine renewable energy developments such as wind farms.

4.1 Fishing Impact

Black bream fisheries are not considered as pressure stock for the purposes of fisheries management within the EU area. This means that they are not subjected to ICES stock assessment and no Total Allowable Catch (TAC) or landing size is prescribed. They are, therefore, fished inshore and offshore by nets and trawl fisheries (Thomas, 2010). It is worth remembering that black bream are thought of as being protogynous only developing into males once a length of 30- 40 cm has been reached. If the larger, more commercially valuable, individuals are removed it may have long term ramifications on the spawning success of the species.

Landings from ICES rectangles 30E8 and 30E9 for years between 2006 and 2010 are shown in [Figure 4.1](#). It is evident that the species is commercially important locally. An apparent recent decline in commercial landings has occurred, reducing from 184 tonnes in 2007 to 129 tonnes in 2010. Off the Sussex coast black bream fishing also occurs on a recreational basis (Vase and Clarke, 2011).

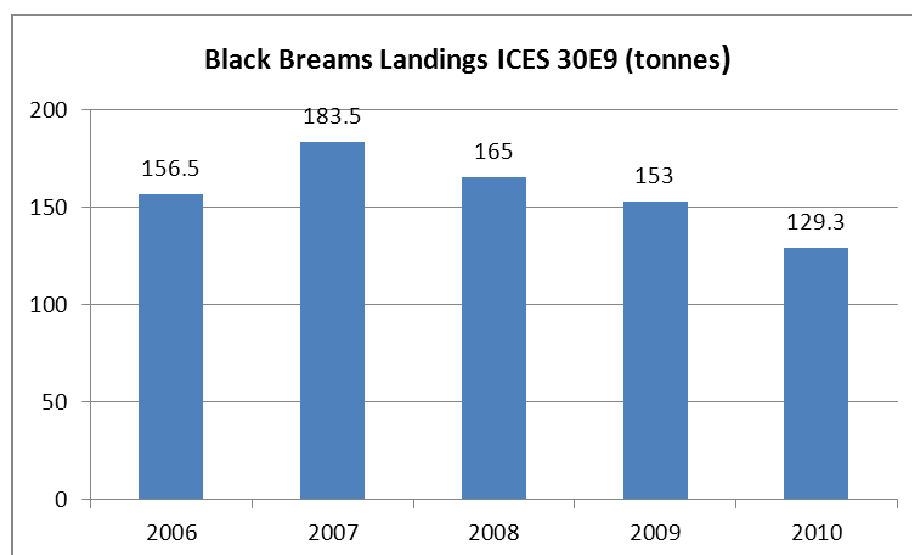


Figure 4.1 Tonnes of black bream landed from the ICES rectangle 30E9 over 5 years showing the local importance of the species.

In the eastern English Channel (and in the area of concern) this species is targeted mainly by pair trawlers (IFSP, 2009) but beam trawls and otter trawls (two of the three main bottom fishing gears used in the area) also target this commercial species (Cefas, 2008). Data are shown in [Figure 4.2](#).

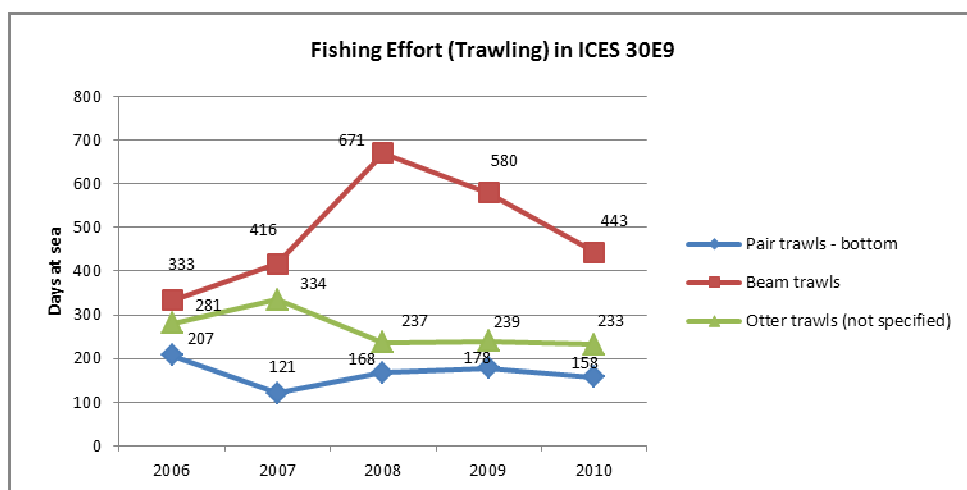


Figure 4.2 Fishing effort expressed as days at sea for ICES rectangle 30E9

4.2 Disturbance of the seabed and sediment plumes

Re-suspension of sediment is caused by activities that involve removal of sediment from the seabed, such as open cut cable laying, dredging and piling. Clearly direct removal of seabed in the area of nests will damage the nests and may also prevent the seabed subsequently being available for nesting due to a physical change in its character. Disturbance to the seabed will also have the potential for releasing sediments that may form a smothering layer over host substrates in the immediate vicinity of the activity but also some distance from the source in the case of disturbed chalks and other fine sediments. Species who spawn over gravel substrates may temporarily lose or be deterred from exploiting viable spawning ground.

Black bream can also be affected by this during the spawning season. Once the eggs have been laid, the males guard the nest from predators and keep the eggs clean by preventing siltation, by using gentle movements of his tail and fins (Wilson, 1958).

Energetically, having to repeat this process more frequently could have a significant impact on the survival of the individuals and hence the population. Potential abandonment of nests may also occur, resulting in failed recruitment to the overall population. Studies in the area are lacking. Similarly, the importance of visual cues in the reproductive process is not well understood and reductions in visibility due to suspended sediments may have an influence on this process.

4.3 Electromagnetic Fields (EMF)

Data on effects of EMF on black bream are not available.

Subsea cable generate DC (steady and slow-varying) generates electromagnetic fields which are parallel to them (Valberg, 2005). Some effects on marine organisms have been recognised due to the presence of EMF emitted from subsea cables, but, excluding elasmobranchs (see Gill *et al.*, 2009 and Kimber *et al.*, 2011), none of the experiments has raised significant concerns and the impact is generally considered low or low-medium for most marine organisms (Switzer, 2010; Polagye *et al.*, 2011).

4.4 Effects of heat from cables

Heat dissipation of power cables is calculated to be up to 100 W/m (Worzyk 2009, as cited in Tasker *et al.*, 2010). It is possible that the heat released by subsea cables has the potential to increase the temperature in the surrounding sediments and water (Boehlert and Gill, 2010) and as these cables will be working for a long time, there is the need to monitor flora and fauna affected, both in the sediment and in the water column (Tasker *et al.*, 2010).

However, field studies are very limited and experiments carried out until now are not exhaustive; so it is not clear to what extent an increase in temperature could affect benthic communities (Boehlert and Gill, 2010) and life stages of fish populations.

Despite the lack of relevant studies, black bream is not considered likely to be affected by heat derived from power cables. Non-buried cables installed on the sea floor are unlikely to heat up the surrounding water as the water itself washes away most of the dissipated heat; however the interface water/cable can be warmer than the surrounding water (Worzyk 2009). In addition, the species is highly mobile and capable of relocating from affected areas and once the cable has been laid, the substrate over and around the cable is unlikely to be suitable as nesting ground for bream.

4.5 Noise

In general fish can detect sounds in the range of 30 Hz to 1 kHz and species with special adaptations can expand this range up to 3-5 kHz, as well as infrasound and ultrasound (Slabbekoorn *et al.*, 2010). However, Hawkins and Chapman (1975) suggest that for teleost fish the ability to discriminate between sound stimuli is far more important than their absolute sensitivity.

Underwater noise/vibrations are detected by fish by the inner ear and the lateral line system (Thomsen *et al.*, 2006). The first one is used to detect high frequency sounds up to hundreds or thousands of Hz and from greater distance, while the second one is generally considered detecting low-frequency sounds (<100Hz) associated with water motion near the body up to one or two body lengths (Slabbekoorn *et al.*, 2010).

Specific studies on the effects of noise and vibration for black bream are not available. This species has a swim bladder; this is known to increase a species ability to detect a wider range of frequencies. At low frequencies fish are believed to hear all in similar ways, while at higher frequencies hearing ability is dependent on the presence of swim bladder and mechanical connection of this with the inner ear (Wahlberg and Westerberg, 2005)

When exposed to a maximum Sound Pressure Level (SPL) of a single sweep of 150 dB_{rms}² re 110 1μPa (0.1-1 kHz), sea bream *Sparus aurata* experienced a significant decrease in blood glucose levels and these levels were highly correlated with motility. This indicates higher consumption of oxygen which means higher energy investment. The use of energy due to disturbance could compromise other biological activities, such as feeding, reproduction and also migration (Buscaino *et al.*, 2010). Banner and Hyatt (1973) and Lagardère (1982), as cited by (Buscaino *et al.*, 2010), after a monitoring study of farmed fish, reported drastic reduction of egg survival and reproductive and growth rates when the animals were exposed to high sound levels.

Oxygen consumption and related energy investment for *Sparus aurata* was different compared to a sea bass species (*Dicentrarchus labrax*) tested at the same time. The sea bass did not show significant differences in glucose levels, and these were not correlated with motility. These observations were considered to be most likely due to differences between species in their recovery time and in the use of glucose for energy (Buscaino *et al.*, 2010). The observations also suggested that sea breams may be more sensitive to noise exposure when compare to sea bass (Buscaino *et al.*, 2010).

² dB_{rms} = root-mean-square

5 CONCLUSIONS

The area of the proposed cable routes for Rampion R3 wind farm development offers a degree of what can be described as favourable habitat for black bream nesting. Adult black bream are known to be present throughout the area with records as far east as Eastbourne. Data on the distribution of juvenile stages are not available, but the species is known to spend the first 2-3 years in coastal areas not far from their nests. As shown in ~~Figure 3.6~~ [Figure 3.6](#), nests are known to be present to the west of Rampion R3 wind farm development along and between the proposed cable areas. A high density of nests is observed in correspondence with the 10m depth contour north of the proposed Kingmere Marine Conservation Zone (west of Rampion R3 wind farm).

Data on distributions of nests are not available for the area in between and to the east of the proposed cable routes, where favourable conditions occur.

Seabed disturbances resulting from construction activities such as cable trenching within the nesting area may damage nests and could potentially prevent future use of the seabed for nest building due to a physical change in its character. Direct disturbance to the seabed will temporarily increase suspended sediments within and around the area of activity. When these sediments drop out of suspension, they may form a smothering layer over favorable substrates in the immediate vicinity of the activity, but also at some distance from the source. Species who spawn over gravel substrates may temporarily lose or be deterred from exploiting viable spawning ground.

Black bream are not included under the European Union fisheries management regulations. This means that there is no landing size limits for this species or Total Allowable Catches. Due to their biology and spawning behaviour, reproduction of the species is more vulnerable to anthropogenic impacts than many other pelagic-spawning fish species; nesting occurs on trawling grounds, making eggs even more susceptible to anthropogenic stressors (Thomas, 2010).

With regards to noise, several studies have shown that low frequency noises of anthropogenic origin can influence the swimming activity of fish, suggesting that sea breams may be more sensitive to noise exposure. There are no data on the effects of piling noise of eggs and larvae of black bream.

Despite the growing knowledge of effects of various anthropogenic stressors (noise and EMF in particular) on fish, it is still supported by very little scientific evidence and lack of species specific habitat distribution and traits knowledge. The subject is still yet to be explored and further studies including a variety of species would be desirable.

6 GAPS IN THE KNOWLEDGE

The following summarises gaps in current understanding in black bream ecology within the vicinity of the Rampion Round 3 wind farm development envelope and which may be required to be filled to inform assessment of potential effects on this species and associated spawning habitat. Where appropriate, field surveys have been proposed to acquire relevant data to improve understanding and assist impact assessment.

- Exact spatial distribution of nests in the cable route area;
- Spatial distribution and ecology of juveniles once hatched;
- Potential effects of noise on eggs and juvenile stages;
- Likelihood of interaction between cable and turbine site with nesting areas;
- Percentage occupancy of nests and nest longevity – i.e. extensive nest areas may be identified but it is not known if these have survived from previous years and if they are, or can be, exploited in the new reproductive season;
- Potential for physically disturbed areas to be appropriate for use by the fish for nesting in subsequent years, i.e. physically disturbed chalk seabed rather than the preferred flat chalk (if any interaction between disturbance and nesting areas are identified); and
- Anticipated extent and period of disturbed sediment plume, both in terms of suspended solids reducing visibility and deposition of sediment on nests.

In order to fill the gaps in the knowledge proposed surveys include:

- Bathy/side scan sonar survey will identify and support mapping of nesting sites on a wider scale to include the Rampion wind farm development area. This should be followed up by drop down video and/or diver surveys to refine the study and provide a better understanding of actual nest utilisation. This combination of surveys should be repeated at time intervals (preferably annually) in order to have a time-series to analysis and monitor the way the nests have been exploited over time;
- Inclusion of the recreational records and larval surveys (if available) would inform the spatial distribution and ecology of juvenile stages. Plankton surveys in the area are suggested after the nesting season and at time intervals to identify spatial and seasonal distributions; and
- Modelling studies on noise and sediment particles dispersion in the area will inform potential effects on eggs and juvenile stages as well as the potential impact of sediment plumes in the nesting areas.

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