



Beatrice Offshore Wind Farm

Proposal for the Undertaking of a Herring Larval Survey

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1 Introduction

Given below is the proposed methodology for the Herring Pre-construction Monitoring Survey.

This report has been prepared by Brown and May Marine (BMM) Ltd on behalf of Beatrice Offshore Windfarm Ltd (BOWL). This report will form part of the Project Environmental Monitoring Programme (PEMP) Section 36 Consent condition (Condition 27). The undertaking and results of the survey will be used to discharge Conditions 34 (requirement for herring surveys) and Condition 12 (Piling Strategy) respectively.

The work will be carried out under a Marine Scotland Science dispensation to land herring and other fish larvae for scientific purposes. This will be applied for upon approval of the methodology by Marine Scotland Science (MSS) / MSLOT.

2 Sampling Methodology

The sampling methodology are based on:

- BOWL Invitation to Tender (ITT);
- BOWL Environmental Impact Assessment (EIA) with particular respect to the noise modelling assessment;
- SSE Safety Health & Environmental (SHE) requirements species for contracts;
- Meeting and discussions held with Marine Scotland Science (MSS);
- IHLS standard methodology; and
- Experience of individuals within SFF and BMM, and previously published herring larval surveys.

In addition, the following assumptions have been made for the survey following discussions with MSS:

- The spatial and temporal distribution of sampling will be designed to ensure adequate coverage of the known spawning areas;
- Sampling effort targeted at producing estimates of various life stages up to 10mm.
- Back calculations from length distributions will be undertaken to approximately determine peak spawning periods;
- Weekly surveys will be replicated over 8 weeks;
- Survey undertaken August to September
- Sampling transects of nominal 1500m length assuming 5 kts, dependant on depth;
- The performance of the survey equipment will be measured by flow rates and sample depth profiles.

2.1 Vessel and Equipment

Following discussions with Scottish Fishermen's Federation (SFF) Services Ltd, two fishing vessels Antaries (BF27; Figure 2.1) and Pleiades (BF155; Figure 2.2) are proposed to undertake the herring larval surveys working on a two week rotation. These vessels have the appropriate certification, equipment and skippers experienced in undertaking surveys.

2.1.1 Antaries (BF27)

Antaries (Figure 2.1) is a steel hulled, 16.70 metre, Fraserburgh based trawler, launched in 2001 which has the required MCA certification and equipment to carry out the specified sampling program. This has passed SFF vessel audits and will undertake an IMCA audit prior to commencing the survey. Details of the vessel's specification are listed in Table 2.1 below.



Figure 2.1 Survey vessel Antaries

Table 2.1 Antaries vessel specifications

Survey Vessel Specifications	
Length	16.70m
Beam	6.45m
Draft	2.76m
Main engine	Caterpillar 3408-DITA-JW 363KW
GPS	2x Koden KGP-913D
Radar	JRC 5200 series (ARPA) & Koden
Plotters	Fishmaster Plotter and Trax Plotter
Sounder	Koden CVS8841
Berths	6

2.1.2 Pleiades (BF155)

Pleiades (Figure 2.2) is a steel hulled, 17.50 metre, Fraserburgh based trawler, launched in 2009 which has the required MCA certification and equipment to carry out the specified sampling program. This has passed SFF vessel audits and will undertake an IMCA audit prior to commencing the survey. Details of the vessel's specification are listed in Table 2.2 below.



Figure 2.2 Survey vessel Pleiades

Table 2.2 Pleiades vessel specifications

Survey Vessel Specifications	
Length	17.50m
Beam	6.65m
Draft	3.07m
Main engine	Caterpillar 3408-480HP
GPS	Furuno SC50
Radar	Furuno Navnet Vx2 (ARPA & Ais modules); Furuno
Plotters	Fishmaster Plotter and Trax Plotter
Sounder	JRc-JFC 130
Berths	8

2.2 Sampling Gears

2.2.1 Herring larval survey

The specifications of the Gulf VII plankton sampler proposed for this survey are given below in Table 2.3. The proposed model is shown in Figure 2.3.

Table 2.3 Gulf VII plankton sampler specifications

Gulf VII Plankton Sampler Specifications	
Frame size	50cm frame with tail fin
Nose cone	20cm
Scripps type depressor	20kg bronze
Drogue	1 standard form
Net	270 micron
Cod ends	Screw fit type
Flow meter	General oceanics mechanical flowmeters (internal and external)
Deployment cable	9mm 6x36 IWRC galv rho 1960 grade MBL:5.76t
CTD probe	SAIV- A/S SD204
Transducer Control Box	PAM 35-10
Dunker	PAM 3 MF 3910
Beacon	1019D



Figure 2.3 BMM Gulf VII plankton sampler model

2.3 Sampling Procedure

2.3.1 *Herring larval survey*

Accepting weather constraints, the objective will be for sampling to be carried out during eight separate trips of four days duration, the first commencing early August and continuing until late September. A consistent sampling pattern will be undertaken with the stations being sampled in the same order each week.

The sampling pattern is given in Figure 2.4 providing for 25 sampling locations encompassed within the 90 dBht ranges modelled for herring and cross referenced with previous IHLS results and the area defined by Coull et al. (1998) as the Moray Firth herring spawning ground. This is in line with the rationale for a grid or evenly spaced stations which is considered to be the best approach for mapping the distribution of fish eggs and larvae.

Trial runs will be undertaken with the Gulf VII to ensure the gear and equipment is working effectively. The vessel will steam along the proposed tow to ensure there are no seabed anomalies that could pose a risk to the Gulf VII plankton sampler. The standard towing speed will be 5 knots, directed into the tide, in a double oblique pattern (V shaped) from the sea surface to within a least 5m of the seabed (target 3m). The deployment and hauling will be continuous, aiming to have 10m of the water column measured for a minimum of 1.5 minutes.

The minimum water depth advised for using a Gulf VII plankton sampler is 15m. Where waters are relatively shallow, a double oblique pattern (W shaped) would be undertaken to ensure adequate coverage of the station.

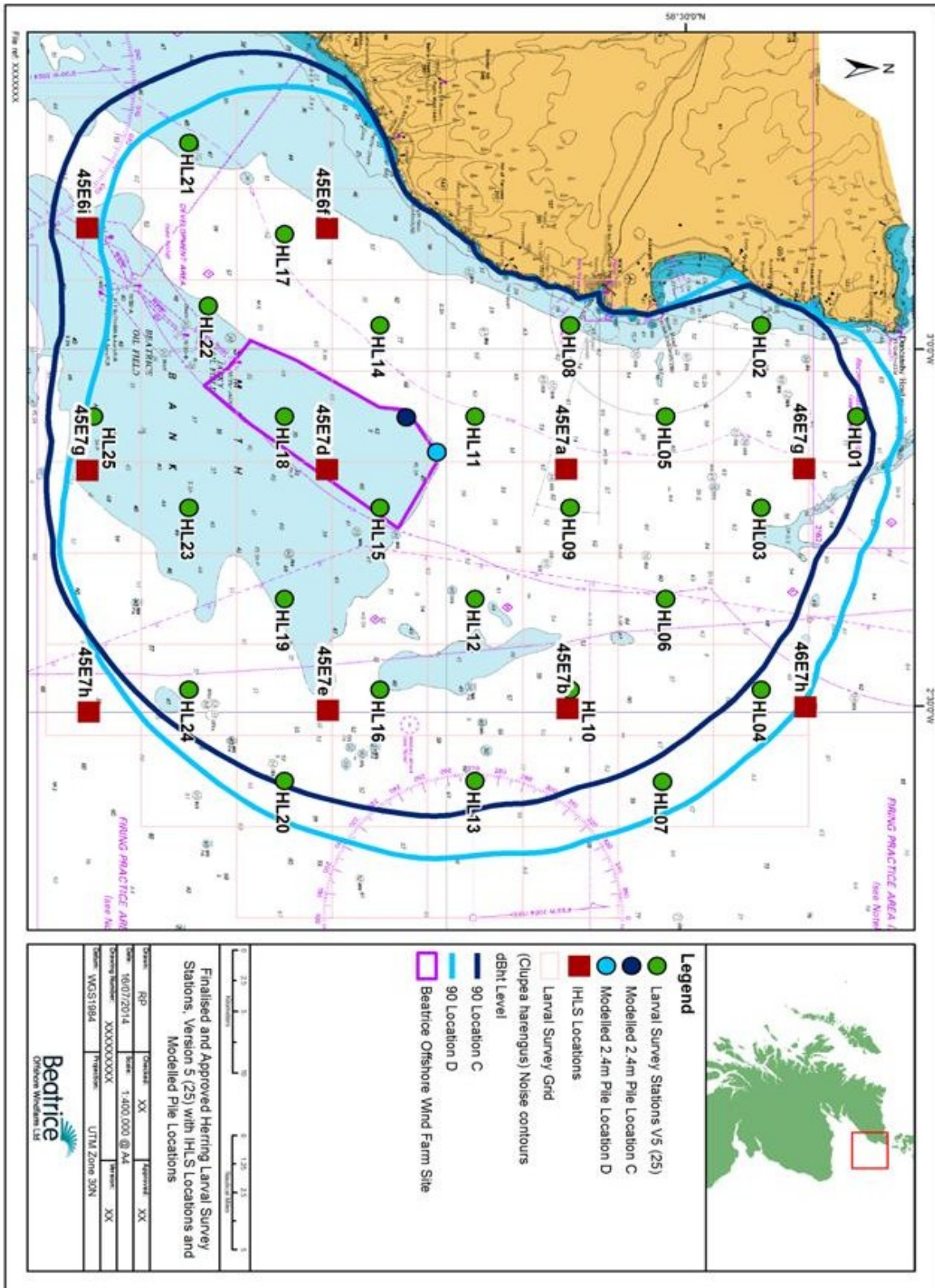


Figure 2.4 Proposed herring larvae sampling stations

Sample stations have been selected to avoid areas less than 15m in depth and proximity to known seabed obstacles. The locations have also been mapped against previous IHLS stations in the survey area. Table 2.4 provides a list of the sample locations illustrated in Figure 2.4 above.

Table 2.4 Proposed coordinates for larvae sampling stations

Station	UTM30N DegDecMin	
	Latitude	Longitude
HL01	58° 37.188	-02° 54.329
HL02	58° 33.198	-03° 01.978
HL03	58° 33.187	-02° 46.702
HL04	58° 33.145	-02° 31.427
HL05	58° 29.204	-02° 54.350
HL06	58° 29.178	-02° 39.104
HL07	58° 28.987	-02° 23.784
HL08	58° 25.214	-03° 01.970
HL09	58° 25.203	-02° 46.752
HL10	58° 25.162	-02° 31.535
HL11	58° 21.220	-02° 54.372
HL12	58° 21.194	-02° 39.183
HL13	58° 21.138	-02° 23.994
HL14	58° 17.230	-03° 01.963
HL15	58° 17.219	-02° 46.802
HL16	58° 17.178	-02° 31.642
HL17	58° 13.232	-03° 09.525
HL18	58° 13.236	-02° 54.393
HL19	58° 13.210	-02° 39.260
HL20	58° 13.154	-02° 24.129
HL21	58° 09.227	-03° 17.059
HL22	58° 10.042	-03° 03.578
HL23	58° 09.234	-02° 46.851
HL24	58° 09.193	-02° 31.747
HL25	58° 05.251	-02° 54.414

In addition to the vessels GPS systems, two Garmin GPSMap278 GPS's with an EGNOS differential would be used to record the vessels steaming tracks and the sampling tracks when the Gulf VII is actually sampling in the water. The tow start times and positions will be taken at the point and time at which the Gulf VII makes contact with sea surface and out-hauling commences. Similarly, the sample end times and positions will be taken at the point and time at which the Gulf VII returns to the surface after either an oblique or a double oblique tow.

For each station, information will be logged on the station number, position, date and time, haul duration, flowmeter revolutions, bottom and sampler depth, water bottom temperature and vessel direction of tow.

2.4 Analysis

2.4.1 *Sample analysis and preservation*

After hauling the Gulf VII, the sampler will be placed in an upright position on deck to ensure that no part of the sample is running out from the net basket back into the net. A bucket will be placed underneath the cod end. The net will then be laid flat onto a plastic tray and gently washed with sea water. This will enable surveyors to very gently tease out any larvae in the net to ensure the entire sample is collected before removing the cod end.

The samples will be transferred into plastic pots and fixed in 4% borax buffered formalin solution in seawater. The plankton volume will not exceed 20% of the pot volume. Additional pots will be used if required.

The pots will be lidded, sealed with electrical tape and labelled with hazard labels prior to storage in a cool, dark area on the vessel. Samples will be transferred on shore at the end of each week. Samples will be regularly transported to the laboratory during the survey campaign.

The larvae will be analysed by experienced specialists as follows:

- Number of individuals per species; and
- Length.

2.4.2 *Data analysis*

All herring larvae per station will be counted and measured.

As the flow of water filtered by the net will be recorded by the flowmeters the number of larvae below a square metre of sea surface at each station will be calculated using the Smith & Richardson (1977) formula.

Length frequency tables will be produced for each survey trip for all herring larvae. Herring larvae will also be categorised by size to separate out the early larval stages and to identify key spawning periods.

Depth profiles will be produced for each station and survey trip and water bottom temperature spatially plotted.

A summary of bycatch larvae and eggs will be produced for each survey trip.

Total herring larvae abundance data will be produced for each station per survey trip.

Herring larvae <10mm abundance data will be produced for each station per survey trip. The analysis of herring larvae <10mm will give a temporal and spatial indication of high intensity spawning periods within the survey area.

Herring larvae <10mm abundance will be used to derive spawning abundance, using hatch size of North Sea herring and mortality rates.

Abundance data of <10mm herring larvae from the survey will be compared to results from the IHLS surveys undertaken in the last two weeks of September. The same dates and size category will be used to allow comparison of numbers at each station from recent surveys (2009-2013) on a year by year basis and in comparison to the 5 year average. This will give an indication of the relative spawning intensity within the survey area compared to previous years for the last two weeks in September.

It should be noted that the 2014 IHLS data will not be available until the production of the ICES report in May 2015 for a direct 2014 comparison.

The raw data from the first two weeks of the survey, along with a worked example (showing full calculations) of how the raw data has been used, will be provided to MSS once BMM has received the analysis from the laboratory. The draft initial data analysis will be sent to MSS for review.

2.5 Reporting

Daily progress reports (DPRs) would be communicated to BMM by 1000 hrs the following morning, and issued to BOWL by 1200 hrs, detailing the work completed, the observed weather conditions, any health and safety issues (including accidents/emergencies) and the forecast for the following day. A daily summary of the number of days spent at sea and in port will also be provided.

Within five days of demobilisation of the survey, a field report will be issued to BOWL giving a summary of the work completed, outlining any health and safety issues and detailing the positions of all sampling undertaken.

A draft report of the survey findings will be issued to BOWL within 30 working days of the receipt of the final laboratory analysis.