

Scapa Flow Wildlife Observations Methodology

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Revision	Date	Description	Originated by	Checked by	Approved by
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Table of contents

1 SUMMARY	1
2 STUDY AREA.....	1
3 SURVEY EFFORT.....	1
3.1 Watch rota.....	2
3.2 Survey methodology – scanning the area	3
4 SIGHTINGS	4
5 DATA RECORDING	5
5.1 Effort and Environment data entry.....	5
5.2 Marine mammal data entry.....	6
5.3 Birds data entry	7
5.4 Shipping data entry	8
6 ESTIMATING THE RANGE DETECTION FUNCTION	8
7 CONTROL SITE	8
APPENDIX 1: Cetacean species frequently sighted around Orkney	9
APPENDIX 2: Seabird species frequently sighted around Orkney	10
APPENDIX 3: Identifying seals at sea	14

1 SUMMARY

Land-based visual observations will be carried out by observers, overlooking the Scapa Flow EMEC wave nursery site in Orkney. Watches will be carried out by an experienced observer during daylight hours, ranging between 04:00hrs and 20:00hrs. The study area will be scanned and the time and location of any marine mammal or seabird sightings will be recorded. Where possible, the geographic location of each marine mammal or seabird group will be recorded using a pre-defined grid. Although marine mammals and seabirds will be identified to species whenever possible, due to the difficulty in differentiating between marine mammal and bird species, especially at distance, additional categories of 'unidentified species' will be included in the species list. Additional information about species sighted will be collected. For marine mammals, group size will be estimated if animals are seen in groups and the location of the centre of the group will be recorded.

Surveys will encompass all states of tide and times of day (during daylight hours) in a systematic manner to ensure there is appropriate sampling of all environmental states. Tide state will be defined in relation to time since the previous high tide recorded at Kirkwall. Data on several weather variables including precipitation, sea state, cloud cover, and wind speed and direction will also be recorded. Data will be recorded on paper sheets by the observer and then transferred into an Excel spreadsheet.

Data from the land-based study described here will provide information on distribution and 'relative' abundance of animals in and around the study area. To inform the analysis on the reliability of detecting animals from a land-based vantage point, the land-based observations may need to be augmented with boat-based surveys along transect lines placed perpendicular to the coast. This information would then enable variations due to detectability differences to be distinguished from genuine changes in abundance, yielding more robust impact analysis. Monitoring of a site with similar characteristics to the test site, yet undisturbed by the presence of wave energy devices, may be valuable in relating any changes observed to the wave devices.

2 STUDY AREA

Due to the size of the study area, which extends along Scapa Flow, it is important that the vantage point selected is of sufficient height to give good visibility across the whole test area. A suitable vantage point, at approximately 5m above sea level, has been identified: this is a point 58°53'28.10"N, 2°55'51.24"W.

In order to aid accurate recording of sightings, the study area has been subdivided into grid areas (see Figure 2).

3 SURVEY EFFORT

This land-based study will record wildlife *sightings* (detailed in section 4) during daily *watches* (section 3.1) by making regular *scans* of the study area (section 3.2) in a consistent manner. The definitions of each of these processes are provided in Figure 1.



Figure 1. Definitions of a watch, scan, and sighting used in this methodology.

3.1 Watch rota

The watch rota is designed to ensure relatively even temporal coverage across daylight hours and tidal states. The number of hours surveyed is based on 5 minutes per cell observing birds and consecutively 5 minutes per cell observing marine mammals (see Figure 2) from the vantage point. Each cell is 1km² and if the observed cell area is less than 1km², then a relative amount of scan time is to be used. The methodology will cover approximately 2 hours from the vantage point twice per week. The adequacy of this sampling rate in providing sufficient power to detect any potential changes will be assessed periodically in the light of data analysis.

To calculate a sufficient spread of the two hour watch periods that should be carried out each day in different months, the time between sunrise and sunset is divided by four periods to the nearest whole number. This results in 2 different watch periods for Jan, Feb, Mar, Oct, Nov, and Dec; 3 periods for Apr, and Sep; and 4 periods for May, Jun, Jul, and Aug. These encompass the periods between 0400 and 2000 (Table 1).

Month	Sunrise	Sunset	Daylight	# of watches	Watch 1 Within	Watch 2 Within	Watch 3 Within	Watch 4 Within
Jan	09:06	15:25	06:19	2	09:00-13:00	11:00-15:00		
Feb	08:22	16:30	08:08	2	09:00-13:00	12:00-16:00		
Mar	07:08	17:42	10:34	2	08:00-12:00	13:00-17:00		
Apr	05:38	18:55	13:17	3	06:00-10:00	10:00-14:00	14:00-18:00	
May	04:14	20:06	15:52	4	05:00-09:00	09:00-13:00	12:00-16:00	16:00-20:00
Jun	03:10	21:11	18:01	4	04:00-08:00	08:00-12:00	12:00-16:00	16:00-20:00
Jul	03:05	21:26	18:21	4	04:00-08:00	08:00-12:00	12:00-16:00	16:00-20:00
Aug	04:00	20:35	16:35	4	05:00-09:00	09:00-13:00	12:00-16:00	16:00-20:00
Sep	05:10	19:12	14:02	3	06:00-10:00	10:00-14:00	14:00-18:00	
Oct	06:17	17:44	11:27	2	08:00-12:00	13:00-17:00		
Nov	07:31	16:19	08:48	2	09:00-13:00	12:00-16:00		
Dec	08:40	15:22	06:42	2	09:00-13:00	11:00-15:00		

Table 1. Number of watches for each month during 2010, with expected daylight hours divided into 2, 3 or 4 watches.

It is acknowledged that there may be insufficient daylight hours on some occasions for the expected number of watches to be completed. This may require a watch to be reduced to three hours on such odd occasions, in which case a clear note to this effect will be recorded.

Each of the watches has been transcribed into a rota (Table 2) that is designed to provide relatively uniform coverage across diurnal and tidal cycles. Although it is understood that some watches will not be able to be carried out for reasons such as adverse weather conditions, it is hoped that the rota can be adhered to as far as possible. If a watch is not carried out on a particular day, there is the scope to transfer that rota number to a day on the following weekend.

Date	Jan-11	Feb	Mar	Apr-10	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1										1	2	
2						3					1	
3	1		1			4		1				1
4	2	1	2					2		2		
5				1						1		
6				2	3							2
7		1	2		4		1		3			1
8		2					2		1			
9											2	
10					1	1					1	
11	1		1			2		3				
12	2							4		2		
13				3						1		
14			1	1	2	3						2
15		1	2				3		2			1
16		2					4		3			
17					3						2	
18					4	4					1	
19	1						1	1				
20	2							2				
21				2		1				2		
22			1	3		2				1		2
23		1	2				2	3	1			1
24		2							2			
25					1					2	2	
26					2		3				1	
27	1						4	4	3			
28	2			1								
29			1	2		3				1	2	
30			2			4		1				2
31	2							2				1

Table 2. Daily watch rota: the watch number for each day refers to the watch periods and months in Table 1

3.2 Survey methodology – scanning the area

A telescope set at 20x magnification is used to scan the channel to detect any animals on the surface of the water. If necessary for identification purposes, magnification is increased up to 60x.

Observing the area by telescope should be carried out in a consistent manner across the pre-defined grid, in a methodical fashion, ensuring the whole study area is covered. For the area closer to land, it may prove more efficient to use binoculars/naked eye for observations. The details of any sightings made (see section 4) should be recorded before moving to the next adjacent cell.

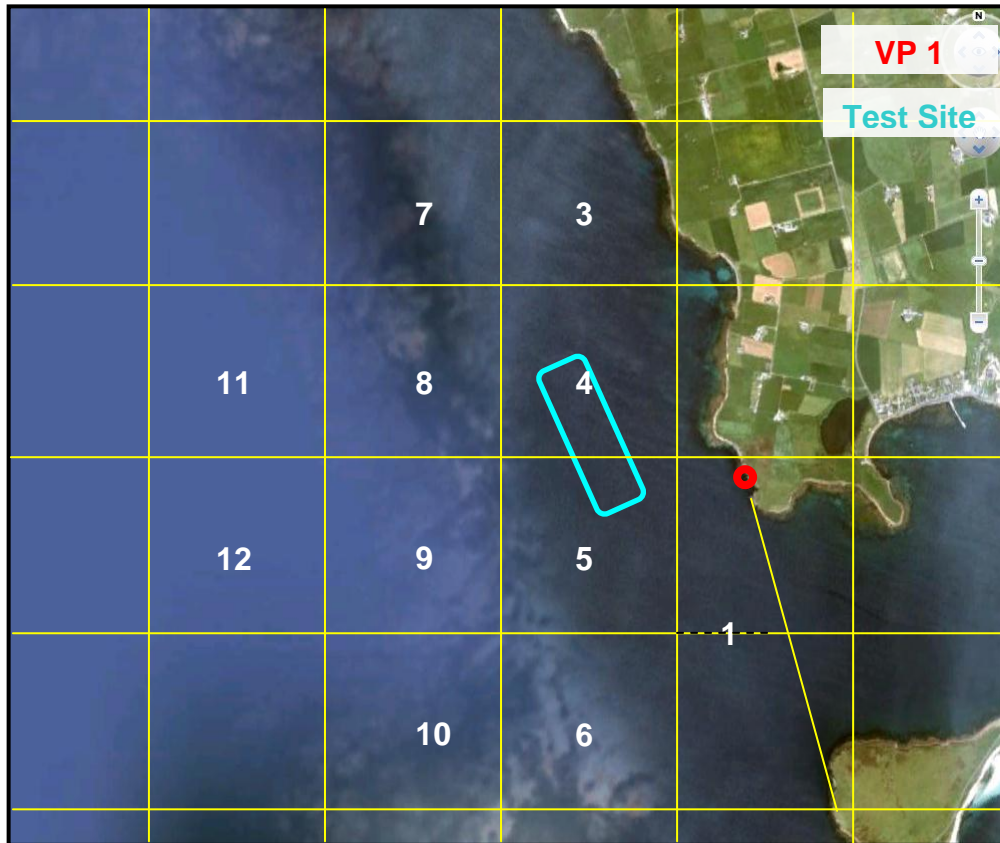


Figure 2: Map of the Scapa Flow wave site, showing the study area extending from the shoreline to approximately 3km offshore and divided into grid sections.

The time required to carry out a single scan of the entire survey area will be designed to maximise the probability of sighting wildlife whilst minimising observer fatigue. This is determined at the start of the fieldwork and maintained throughout the project. A period should be taken between scans to reduce observer fatigue and to allow data entry to be updated. To avoid potential subliminal observer bias associated with knowledge of operations within the survey area (which may lead to, e.g., over- or under-reporting of animal occurrence/behaviour), it is important that the observer is not made aware of site operations. Although it is clear that operations such as ship movements will be observed and interpreted by the observer, as far as possible, communication to the observer of operations such as device activity (active/not operating) should be avoided.

Calibration surveys will be undertaken to confirm the observers grid cell recording by using a boat travelling along transect lines at a constant speed. The boat position at the time of the sighting (LAT LONG), and the range (metres) and grid square of the sighting should be recorded.

4 SIGHTINGS

A wildlife 'sighting' is defined as the observation of an individual or group of birds or marine mammals (or other relevant species e.g. basking shark) made during a visual scan of the study area. It is important that consistent methodical scanning (as described above) is maintained throughout: the observer should avoid interrupting a scan to focus directly onto a bird or marine mammal individual or group that has been sighted outside the scan limits (e.g., in peripheral vision, or tracking an animal sighted during a previous scan). If a unique sighting is made outside the scan period then this must be recorded, with details entered in the 'Comments' section at the end of the environment data entry section.

To estimate the geographical location of the animal(s) sighted, the associated grid overlaid on the map is used. When sighting a group of animals, the centre of the group should be aligned with the centre of the field of view. Calibration of the locations defined by the project matrix grid references can be carried out using a boat-based differential GPS system: the boat should be manoeuvred around the study area and the recorded grid square locations compared to the GPS locations. It is anticipated that this should take around a half day and should be carried out near the start of the study.

A group is defined as all animals within approximately 100m of each other. Consequently, animals further apart than this distance will be defined as different groups or individuals. Distance estimation at sea is often challenging and it can be useful to train observers to estimate distance using marks of known range (e.g., marker buoys) or size (e.g., ships and boats). When a group of wildlife is sighted, key information about its location, group size, and behaviour should be recorded. Birds should only be recorded as sightings when on the water or hovering directly above the surface (within a few metres). Birds flying higher than this or birds that are clearly transiting through the study area should not be included as sightings.

An estimate of the number of individuals in each group should be made. For cetaceans, this can be challenging in the field (particularly from land-based observation platforms) because all of the animals within the group are unlikely to be observed at the surface at the same time. When observing a group of cetaceans, group size can be estimated through interpreting the synchrony of surfacings, spatial locations of surfacings relative to each other, and the identification of distinctive individuals (e.g., calves and adult male killer whales). However, a good rule of thumb that is often used to support estimated cetacean numbers is to count the total number of surfacings sighted within the mean dive duration of each species (Appendix 1).

If different observers are used, it is worth undertaking a calibration exercise to indicate any differences in estimates between the observers. This could be done for both group size estimates and location of specific sightings to grid squares, and would inform the analysis by reducing the unknown variability between different observers. Thus, two observers would make independent sighting allocations to grid squares, and group size estimates for the same groups. No communication about estimates should be made between the observers during this calibration. It is estimated that a total of at least 12 comparisons should be made for each animal group (cetaceans, seals, birds).

5 DATA RECORDING

Data is recorded to paper forms directly by the observer and then transcribed into a standard Excel template. The parameters within the template are described in the following sections.

5.1 Effort and Environment data entry

Factors such as sea conditions, light conditions, or precipitation will have an effect on both the probability of sighting animals and the range over which they can be observed. It is therefore important that a regular record of the meteorological and sea conditions is maintained throughout the watch. Furthermore, to accurately interpret the data collected (e.g., sighting rates), it is critical that a robust record of 'observer effort' be provided. If the observer effort changes during the watch (e.g., additional or different observers carry out survey or there is a pause in surveying due to adverse weather), this should also be recorded.

The EFFORT and ENVIRONMENT form should be completed immediately at the start of the watch and thereafter if these factors significantly change. Observations should only be carried out in sea states up to Beaufort 4 (inclusive), and should be terminated in the event of significantly reduced sighting conditions (e.g., thick fog or torrential rain). The data should include:

DATE	Date of the watch
TIME	Time (GMT) of the environment recording
VANTAGEPOINT	Vantagepoint 1

TIDE STATE	The state of the tide; FLOOD, EBB, or SLACK (within one hour either side of high or low water)
WEATHER	The current weather conditions. Data is limited to FAIR, RAIN, FOG, or SNOW
VISIBILITY	The estimated visibility range (km).
CLOUD COVER	The estimated cloud cover in octaves where 0 represents a clear sky and 8 is overcast
WIND STRENGTH	The current wind strength as described by the Beaufort scale.
WIND DIRECTION	The current wind direction (the direction it comes from) as an approximate compass bearing (N, NE, E, SE, S, SW, W, NW). If there is no wind, enter NA.
SEA STATE	The current sea state as described by the Beaufort scale.
SWELL HEIGHT	The estimated height of the sea swell in metres.
GLARE EXTENT	The extent of sun glare if any is present of the surface. Limited to NONE, SLIGHT, MODERATE, and SEVERE.
COMMENTS	Any additional details about the weather conditions throughout the watch period.

5.2 Marine mammal data entry

The following information should be recorded for every marine mammal sighting made during the scans:

DATE	Date of the watch.
TIME	Time (GMT) of the sighting.
SIGHTING EQUIPMENT	The equipment used to sight the marine mammal(s).
GRID SQUARE	The grid square in which the sighting was made.
SPECIES	The species sighted. As it is often difficult to distinguish birds to species levels, the option is given to enter 'Unidentified'. Further details can be provided in the COMMENTS section.
NUMBER	Estimated number of animals in the group.

Details of the following animal behaviours should also be recorded. Any combination of these can be included.

Behaviour - All

FEEDING	Any sighting where a fish is observed being chased or manipulated at the surface
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Behaviour - Cetaceans

AERIAL BEHAVIOUR (excluding REGULAR SURFACINGS)	Any overt behaviour where all or part of the body clears the water
REGULAR SURFACING	The dorsal portion of the body, excluding the tail flukes, clears the water in a forward roll motion.

BOW RIDING Any behaviour where the animal(s) are in close proximity to a vessel (<10m)

Behaviour - Seals

STATIONARY The seal is stationary at the surface with its head above the water surface.

SWIMMING The seal is making progress at the surface with its head above the water surface.

BOTTLING The seal is stationary at the surface with its head above the water surface for an extended period. The orientation of the head is perpendicular to the water surface so that the nose is pointing directly upwards.

COMMENTS Any other relevant information about the sighting should be included here. This may include details such as a record of the age classes of the animals (i.e., if there are any relatively small animals in the group).

5.3 Birds data entry

The following information should be recorded for every seabird sighting made during the scans. Records should be limited to birds that are on the water or that or hovering directly above it (within a few metres), ensuring that the grid square to the location on the water below hovering birds is recorded.

DATE Date of the watch.

TIME Time (GMT) of the sighting.

SIGHTING EQUIPMENT The equipment used to sight the bird(s).

GRID SQUARE The grid square to which the sighting was allocated.

NUMBER OF SPECIES As birds often form mixed groups, provide the number of species within each group.

SPECIES The species sighted. As it is often difficult to distinguish birds to species levels, the option is given to enter 'Unidentified'. Further details can be provided in the COMMENTS section.

NUMBER Estimated total number of birds (regardless of species) in the group.

Details of the following bird **behaviours** should also be recorded. Any combination of them can be included.

DIVING FROM FLIGHT One or more birds diving underwater from a hovering or flying position.

DIVING FROM WATER One or more birds diving underwater from a position on the water surface.

SWIMMING AT SURFACE The birds are making progress at the surface.

STATIONARY AT SURFACE The birds are stationary at the surface.

COMMENTS Any other relevant information about the sighting should be included here. This may include details such as a record of the age or sex classes of the birds (i.e., if there are any relatively small animals in the group or if there are predominantly males or females).

5.4 Shipping data entry

The following information should be recorded for every vessel sighted during the scans.

DATE	Date of the watch.
TIME	Time (GMT) of the vessel sighting.
SIGHTING EQUIPMENT	The equipment used to sight the vessel(s).
GRIDSQUARE	The grid square in which the sighting was made.
VESSEL NAME	The name or registration number of the vessel, if visible.
VESSEL TYPE	The type of vessel. Data is limited to FERRY, FISHING VESSEL, KAYAK, LARGE COMMERCIAL VESSEL, POWERBOAT (<10M), POWERBOAT (>10M), WAVE ENERGY DEVICE, and YACHT. If a different type of vessel is sighted, record the closest match and provide further details in the COMMENTS section.
ROUTE	A standard diagram of vessel routes through the test site has been developed.
COMMENTS	Any other relevant information about the vessel should be included here. This may include details such as the activity of the vessel (e.g., fishing).

6 RANGE DETECTION

An important caveat associated with studying the distribution of animals from a fixed location is that the probability of sighting an animal, or group of animals, decreases as an unknown function with distance from the observer. It is important therefore, to highlight that data from the land-based observations described in this methodologies will only provide information on the distribution and 'relative' abundance of animals in and around the study area. This issue of detectability with range is also particularly important in a study such as this one where wave devices may be moored several kilometres from shore; the power to detect changes will inherently be lower at greater ranges without knowledge of the detection probabilities.

7 CONTROL SITE

Baseline monitoring of a different site with similar characteristics to the test site, yet relatively undisturbed, has been suggested, and may be valuable in determining if potential changes observed in the wave test site are restricted to, or can be ascribed to the impact of devices.

It would indeed be very useful from an analytical perspective to have a reliable control site, whose characteristics were sufficiently similar to the test site as to make a Before-After-Control-Impact (BACI) analysis meaningful. However, the reality of finding another such site, experiencing the same range of variables, within a dynamic and changing environment, makes this difficult to recommend at a generic level. It is likely that large numbers of 'control' sites would need to be sampled in order to provide sufficiently robust data on which to make assessments of potential impacts that may be ascribed solely to the presence and operation on wave energy devices.

Other possible sources of comparative data might include the distant zones of survey area beyond the extent of the immediate testing area, or utilising population statistics. One way or the other, it is important to be wary of incorrectly assigning any decline of a species to the presence of wave devices, since there are numerous other variables to which such a decline could potentially be ascribed, and the potential use of a 'control' site needs to be further discussed in the light of such lack of clarity.

APPENDIX 1: Cetacean species frequently sighted around Orkney

Harbour porpoise



The harbour porpoise is the smallest cetacean found off the coast of the UK. It has a small, rotund body, blunt head, no beak, and a small triangular dorsal fin. Adults are approximately 1.4-1.6m in length. Mean dive duration: 20 sec.

White beaked dolphin



The white beaked dolphin is a stout dolphin, about 2.5-2.7m in length; it has a short, often white beak, and black back and a pale grey to white area behind the dorsal fin that extends to a blaze on the flanks. This forms a diagnostic "saddle" on the back. Mean dive duration: 20 sec.

White sided dolphin



This bulky dolphin can be confused with the white beaked dolphin and often forms mixed groups with this species. It reaches around 3m in length and can be distinguished from the white beaked dolphin by its all-black back and elongated yellow-ochre band on its flanks. Mean dive duration: 20 sec.

Risso's dolphin



The Risso's dolphin is a large, robust dolphin around 3.5m in length. They have a blunt, rounded head, and a slight melon with no beak. It is distinctively grey in colour, often with numerous white scars on the flanks. Mean dive duration: 20 sec.

Killer whale



Killer whales are large, reaching around 9m in length. Males have a very tall, triangular and erect dorsal fin. Immatures and adult females have a smaller sickle-shaped fin. They have a conical shaped black head with a distinctive white oval patch behind the eye, and a grey saddle behind the dorsal fin. Mean dive duration: 40 sec.

Pilot whale



Pilot whales reach approximately 6m in length and have a bulbous, square head. The fairly low, long-based dorsal fin is situated forward of the centre of the back. It is sickle shaped and becomes flag shaped in older animals. The body is black or dark grey in colour. Mean dive duration: 70 sec.

Minke whale



The minke whale is the smallest of the baleen whales in the UK. Growing to a length of 7-8.5m, it can be distinguished by a white diagonal band on the flipper, a small, pointed triangular head, and the lack of a conspicuous blow. Mean dive duration: 60 sec.

APPENDIX 2: Seabird species frequently sighted around Orkney

Auks



Razorbill



Guillemot



Black guillemot



Puffin



Little auk

Ducks, swans, and geese



Mute swan



Whooper swan



Common scoter



Eider



Goldeneye



Long tailed duck



Mallard



Pochard



Scaup



Shelduck



Red breasted merganser



Tufted duck



Wigeon



Greylag goose



Pink footed goose



White fronted goose

Terns



Arctic tern



Common tern



Sandwich tern

Cormorants and shags



Cormorant



Shag

Divers



Black-throated diver



Red-throated diver



Great northern diver

Skuas



Arctic skua



Pomarine skua



Great skua



Long-tailed skua

Gulls



Black-headed gull



Common gull



Herring gull



Great black-backed gull



Lesser black-backed gull



Kittiwake

Other



Gannet



Fulmar



Storm petrel



Manx shearwater

APPENDIX 3: Identifying seals at sea

Harbour seal



HEADS IN WATER:

Harbour seals have a dished shaped forehead (they have relatively distinct foreheads. Their eyes are very much on the front of the face, close to the nose. In terms of overall head shape, an oval drawn around the head (when viewed face on) would need to be squashed from top to bottom.

MARKINGS:

Harbour seals are usually fairly uniformly spotted.

BODY SIZE:

Harbour seals are the smaller of the two species with adults measuring around 1.3-1.7 m long.

Grey seal



HEADS IN WATER:

Grey seals have relatively flat noses and their eyes are located midway between the nose and the back of the head. Unlike harbour seals, grey seals have 'double chins'. In terms of overall head shape, an oval drawn around the head (when viewed face on) would need to be squashed from side to side.

MARKINGS:

Female grey seals have contrasting pale bellies and darker grey backs, with large irregularly shaped spots and blotches. Male grey seals have darker, more uniform, coats than females.

BODY SIZE:

Grey seals are the larger of the two species with adults measuring around 1.8-2.1 m long
