Appendix J – Navy Lookout Protocol, Revised December 2010

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Calibrating US Navy lookout observer effectiveness

Information for Marine Mammal Observers

Version 2.1

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CONTENTS

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1. INTRODUCTION

1.1 Aim of the project

The US Navy use lookouts (LO) to detect anything in the water, including marine mammals. Depending on the nature of the activity the vessel is engaged in, action may need to be taken if the animal is within certain ranges of the vessel. Therefore, it is important to be able to detect all animals that come within these ranges and also determine how far away the animals are with accuracy. Lookouts are positioned so that the waters all around the vessel can be searched. As well as dedicated lookouts, officers on the bridge may also be searching and acousticians may also be listening for vocalisations (although we assume that visual confirmation is required before the encounter is classed as a detection). We refer to all of these observers together as the "observation team" (OT). The aim of this project is to calibrate the OT effectiveness in terms of detecting and identifying marine mammals. Of particular interest is the probability of an animal getting within a defined range of the vessel without being sighted by the OT, as well as determining the accuracy of the OT (primarily the LO) in determining species group (whale, dolphin, etc.) group size and position. In order to achieve this, experienced marine mammal observers (MMO) are required to be searching and collecting information on marine mammals that both they and the OT detect.

1.2 Overview of analysis methods

Three statistical models are required to estimate the probability of an animal getting within a defined stand-off range without being detected by the OT: (1) a model of the probability that an animal, or group of animals, at the surface is detected by the OT as a function of the animal's position relative to the vessel; (2) a model of surfacing behaviour of the animal/group; and (3) a model of animal/group movement. The data collected during the survey described here will be used to parameterize the first model. The latter two models will be parameterized from literature sources. To obtain parameters for the first model, the data required will be information on every surfacing of an animal (or group) detected by the MMOs and whether or not the OT saw it.

Since the action taken by the vessel once a sighting has been made depends on the distance recorded by the OT, and to some extent the species, we will also make an assessment of the accuracy of distance and species (or species group) determination – although the only data we have to compare this with are the distances and species recorded by MMOs, which may also not be error free. Therefore, while we can estimate the magnitude of the differences between OT and MMO distances and species determinations, we cannot make statements about absolute accuracy of either.

1.3 Overview of survey methods

In order to obtain a realistic probability of detection of every surfacing for the OT, it is important that the OT search as usual. However, some additional information from the OT will be required: namely, information on every surfacing if possible. Since this is not typically recorded, and we do not wish to interfere with the normal operation of the OT, we designate one of the MMOs to ensure that this information is obtained (as detailed below). This MMO will be called the liaison MMO (LMMO) since they need to liaise with the OT. The other MMOs also search and record every surfacing, in such a way

that the OT do not know what they are doing. To distinguish them from the LMMO, we refer to them as surveying MMOs (SMMOs).

With the SMMOs searching and recording every surfacing, a combination of line transect distance sampling (DS) and mark-recapture (MR) methods can be used to estimate the required probability of detection for each surfacing. These methods are frequently used in surveys of marine mammal surveys, but generally without the complication of recording each surfacing. The idea is that when the SMMOs detect an animal surfacing, they are setting up a "trial" for the OT, which can either result in the OT detecting that surfacing or not. The model assumes that probability of detection is a function of distance (both ahead and abeam of the ship), whether that group was sighted by the OT before and potentially other variables. Animals (or groups) that are more-or-less continually at the surface (such as large groups of dolphins) can be analysed in a similar framework, but here the probability of detection is modelled as a continuous hazard rather than only when discrete surfacing occurs. The data required for continuously available animals is: when and where the SMMOs first detected them, regular updates on position, when and where the OT first detected them (if they did), when and where the OT lost contact with them and when and where the SMMOs lost contact with them.

The primary members of the OT are the dedicated LOs; however there are also observers on the bridge and possibly an acoustic 'observer', although the search effort for these observers will be variable depending on their other duties. Nevertheless, sightings information from these observers will also be required. We plan that the LMMO will be stationed next to the LO; hence it is important that other members of the OT communicate their detections to the LO so that the LMMO can record them. If this does not happen, it may be necessary to station an additional LMMO on the bridge, so they can record detections made by the bridge observers.

A key element of this method is that the OT must search as usual and search independently from the SMMOs. If the LO or other observers are aware of sightings made by the SMMOs, the premise of the analysis will break down.

Another key element is that the SMMOs must be able to determine if a detection of a surfacing they have made has been detected by the OT or not (i.e. was the trial a "success" or "failure"). The LMMO is responsible for communicating all OT detections to the SMMOs, who can then judge if this corresponds with to a detection they have made. Also, information about the timing and location of detections will be recorded (by the LMMO for OT detections and by the SMMO for SMMO detections) so that determination of which are duplicates can be refined offline, after the survey.

In addition to the detection probability information, SMMO observers will also provide information on species and group size with which to calibrate the OT.

The most important surfacings are those made before the OT detects the animals, and the first surfacing detected by the OT. Thereafter, repeat detections of the same animal/group by the OT are useful information for refining the detection function shape, and for gleaning information about surfacing rates, but do not bear directly on the main question we wish to answer. Hence, most effort by the SMMOs should go into detecting marine mammals before the OT has seen them, and determining whether each of these surfacings is detected by the OT. Once a group has been detected, the SMMOs should feel free to concentrate on searching for new animals/groups, unless tracking of already detected groups is straightforward. One of the two SMMOs should be searching for new groups, especially if the other SMMO is following a group. The SMMOs are encouraged to search with binoculars or big eye binoculars as much as possible.

1.4 Overview of the manual

This manual describes the survey protocol and sighting procedures of the various observers and details the data to be collected. It should be borne in mind that the protocol may need to be adapted if procedures are found to be infeasible. Contact details for the St Andrews team are given in section 1.5.

1.5 Contact details

If anything is unclear, or the protocol can not be implemented, then do not hesitate to contact the support team at St Andrews University, Scotland. Note that the UK is 10 hours ahead of Hawaii.

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1 SURVEY PROCEDURE

1.1 Search platforms

2.1.1 Frigate

The platforms available for observation on a frigate are the bridge, bridge wings (with Big Eyes installed), the upper bridge and the fantail (at the stern of the ship).

1.2 Observer configuration

2.2.1 OT

Dedicated LOs are positioned on the upper bridge and fantail with additional observers operating opportunistically on the bridge. On destroyers or cruisers Los will be located on the bridge wings. An acoustic observer may also be available. We assume that the forward LO (on the upper bridge of a frigate) will be the one primarily making confirmed sightings, and that all sightings by other members of the OT will be reported to them. Officers on the bridge or in combat operations center are responsible for entering marine mammal records into a log (Appendix B); this log will not be used in the current survey as it is not sufficiently detailed for our purposes – instead the LMMO will keep detailed records (see below). All OT personnel should search independently of the SMMOs.

2.2.2 MMO

Four MMO are required; two on the bridge wings who are actively searching (SMMOs), one with the navy LO on the upper bridge (the LMMO), and one recording data (DMMO). The primary purpose of the LMMO on the upper bridge is to record all detections and surfacings detected by the OT. The MMO should all be in contact with each other and also be aware of any sightings made by the OT.

It is anticipated that the MMOs will rotate positions, for example, port SMMO, LMMO, starboard SMMO, DMMO (resting).

It is also conceivable that the LMMO may sometimes be able to operate as an additional search platform, aiding the SMMOs, if they are able to stand behind the LO and hence not cue them with their sightings. This is something that will need to be determined on board the vessel.

It is our hope that the MMOs will be able to use headset radios to communicate among themselves with the DMMO recording data and prompting SMMOs for additional information. Looking down greatly increases the chance of losing a tracked animal, missing sightings, etc.

2.3 OT procedure

It is important that the OT search as usual and independently of the MMO. Having detected a marine mammal, the LO should report each surfacing of the group they detect to the LMMO. The LMMO will be positioned on the upper bridge will record this information. However, the LO should not alter their usual search behaviour in order to better detect repeat surfacings – they should carry on with whatever search behaviour they would use if the MMOs were not present.

If the bridge, or other member of the OT, detect an animal, they should inform the LO. This will both inform the LMMO who can record the information and allow the LO to track each surfacing. It is not necessary for the bridge or other observers to inform the LO of each surfacing they detect after the first one, if it is obvious it is of the same group, unless this is their normal procedure. As stated earlier, we are not focussed on repeat surfacings.

It is our understanding that OT have access to a compass and this should be used to determine the angle from the trackline to the sighting if this is their usual method. Distances are estimated by eye.

2.4 SMMO procedure

The main functions of the SMMO are to detect and track marine mammals and determine whether sightings made by the OT and reported to them by the LMMO are duplicates with sightings they have made. The SMMOs should search from the vessel to the horizon using binoculars concentrating forward of the vessel to abeam. The search pattern is:

- Port observer: searches on the port side of the vessel from about 5^{o} starboard to abeam.
- Starboard observer: searches on the starboard side from about 5^{o} port to abeam.

On detecting an animal, they should attempt to record each surfacing until the animal goes abeam. Tracking an animal has three uses: it helps to identify any animals subsequently seen by the OT; species and group size can be more accurate (because animals and groups are seen more than once) and information on surfacing behaviour is required for the analyses. The MMOs will need to be in contact with each other and thus be aware of any sightings made by the OT which will help with duplicate identification; duplicate sightings are animals seen first by the SMMO and then by the OT (as reported by the LO via the LMMO).

If the OT detect an animal prior to the SMMO, then the SMMO should attempt to locate it to determine species and group size and then continue to track and record each surfacing (but see section 3.4, below). If the OT sighting occurs during SMMO tracking, the SMMO should continue to track the animal until it is lost, or goes abeam, and then attempt to locate the sighting made by the OT.

SMMO should primarily concentrate their search effort forward of abeam but if substantial numbers of animals approach the vessel from behind abeam (i.e. dolphins that can swim faster than the vessel) then it may be necessary to search behind abeam.

Angleboards should ideally be used to measure bearings to sightings relative to the ship and the binoculars should have reticles for use in calculating distances.

Each SMMO should submit information via radio to the DMMO for data entry into the sighting form. Effort information should be recorded on an MMO effort form.

The SMMOs assess the duplicate status of each surfacing.

If there are too many animals in view for an SMMO to keep track of, the SMMO should choose a small number of trials (one or two) that they can track accurately and follow them until it is clear the OT has duplicated that target or the track ends.

2.5 LMMO

The primary function of the LMMO is to record information (section 4) on the first sightings of all the OT. Information on all subsequent sightings should also be recorded if possible. The LMMO will pass the information of sightings to the SMMOs as soon as possible to determine if the OT has duplicated as sighting made by the SMMOs. In some cases this will inform the SMMOs of animals not yet detected. The LMMO can also actively search for animals and inform the SMMOs of any sightings they make (so the SMMOs can use them to set up trials), as long as this does not cue the LO or compromise data recording.

3 SIGHTING PROTOCOL

This section relates to the procedure to be followed on detecting a marine mammal.

3.1 LO

On sighting a marine mammal, the LO should inform the LMMO giving all required information (see section 4) but in particular time of sighting, species group, sighting angle, sighting distance and group size. The LO should also give the information for any subsequent sightings of the same group to the LMMO.

3.2 Bridge (or other OT member)

On sighting, or detecting, a marine mammal, the bridge should inform the LMMO – this may be via the LO if LMMO is not in direct contact with the bridge. Subsequent sightings of the same should also be passed to the LO, although it seems likely in practice that the primary responsibility for tracking already sighted groups within the OT will fall upon the LO.

3.3 SMMO

On sighting a marine mammal, the SMMO should

1. Relay “sighting” to the DMMO.
2. When prompted by DMMO, provide the following information: species, sighting angle, sighting distance and group size. Other information (such as cue or behaviour) should be collected if there is time.
3. Attempt to track the animal, recording information on all subsequent sightings.
4. Assess duplicate status, maybe in consultation with the LMMO.
5. Inform the bridge of any animal within the operational standoff range of the vessel if active sonar operations are taking place.

3.4 Tracking priority

The first priority for SMMOs is to find and track animals before the OT see them, to set up trials for the OT. When the OT report a sighting (via the LMMO) of a new group they should determine whether it is a duplicate or not (i.e. something they were tracking already). A secondary priority is to track groups already seen by the OT, to determine resighting rates. With this in mind, the procedure for SMMOs on detecting an animal is as follows:

- On locating an animal, or group, attempt to track until the animal is lost or is a long way behind and unlikely to approach the vessel.
- If the OT detect an animal while both SMMOs are searching (i.e. not tracking anything), one SMMO should attempt to locate the OT sighting (to confirm species and group size) and continue to track it and record each surfacing. This will be necessary to determine how many surfacings the OT detect. The other SMMO should continue to search as setting up new trials is more important.
- If the OT detect an animal while one SMMO is engaged in tracking, that SMMO should determine whether the OT sighting is a duplicate or not. If it is, the SMMO should continue tracking the group while the other SMMO searches for new groups. If it is not, the SMMO should continue tracking their group, while the other SMMO attempts to track the group seen by the OT, if possible. If this is not possible, the other SMMO should revert to searching for new groups to track.
- If the OT detect an animal while both SMMOs are engaged in tracking, the SMMOs should continue determine if the OT sighting is a duplicate or not. In either case, they should continue tracking their groups until the track is finished or the group is sighted by the OT.

3.5 Group size definition

In the case of aggregated groups, the angle and distance measurement should be estimated to the geometric centre of the aggregation. A group can be thought of as the smallest unit that can be tracked as a unit. A convenient rule is, for example, to define a group as containing animals not more than 3 animal lengths from each other (this may depend on species). The group may exhibit the same swimming pattern and general behaviour although not necessarily with a synchronised surfacing pattern.

Difficulties may arise when animals are not in tight, easily defined clusters, but in loose aggregations whose boundaries and group size must be determined subjectively. In this case, it is better to identify smaller, homogenous groups within the aggregation, and associate each with an angle, distance and group size.

Problems can also arise when a group is formed of animals swimming in a long line at relatively equal distances from each other (e.g. pilot whales). In this case, group boundaries can be taken at convenient discontinuities in the distribution.

Large groups of dolphins may comprise of several hundreds of animals. Often these groups are compact and form a single unit. Sometimes subgroups may form but may only last for a short time with frequent interchange of animals between groups. In this case, it is better to treat the whole group as a single unit. As these groups will have a continuous cue, it is not necessary to make continuous resightings, but only at appropriate intervals, say 5 minutes or perhaps more frequently close to the vessel.

If relatively stable subgroups can be identified, then the details for the first subgroup sighted should be recorded and then this subgroup should be followed. Include a comment that it is part of a larger aggregation, and if possible, how many other subgroups there are in the aggregation and group sizes. A duplicate sighting would occur if the OT detects the subgroup being tracked.

If a groups splits while being tracked, then one subgroup should be tracked. The groups sizes recorded should reflect that the group has split and is now smaller than the original sighting. The fact that the

group has split should be recorded in the data. When tracking of the subgroup has finished, the SMMO should then try to relocate one of the other subgroups and track it.

3.6 Surfacing and availability

A surfacing is defined as any opportunity that an animal is available to be detected visually. This could be when the animals are at the surface or even below the surface if the water is clear enough.

Some animals may be intermittently available, for example if they are at the surface for a short time and then dive and then return to the surface. Others might be continuously available, for example large groups of dolphin schools which surface asynchronously. As ever, it is important to record the first sighting of these and as discussed in section 3.5, record the final sighting and, if feasible, at appropriate intervals such as every 5 minutes.

Some animals may provide both intermittent and continuous cues (i.e. a blow but then stays close to the surface and if the water is clear enough can still be seen). In this case, treat each discrete surfacing (ie. fluke, blow, body) as a resurfacing but include a comment that the animal is continuously available.

4 DATA COLLECTION

It is anticipated that data will be recorded by the DMMO onto paper forms and transcribed at the end of each day. The information collected by the OT is recorded by the LMMO onto a sightings form. Sightings by the SMMOs are recorded or transcribed onto a MMO sighting form. Forms for search effort and weather and other basic information are also provided. Note the form number and total number of forms (at the top of the paper form) is used to prevent forms being lost.

4.1 Sightings form

This form should be used to record all sighting information. All information is required upon initial sighting. Information needed for each resurfacing is indicated in bold.

FIELD	DESCRIPTION
SIGHTING #	**This is the number of each sighting and should be sequential.**
RESIGHTING #	**The number of times the object has been resighted. The initial sighting will have a resighting number of zero and subsequent resightings will be 1, 2, etc. Each resighting starts a new column on the sighting report form.**
RESIGHTING. STATUS	**D definite resightings (at least 90% likely to be the same animal or group)** **P possible resighting (more than 50% likely)** **R remote resighting (less than 50% likely)**
TIME	**Time of sighting.**
SPECIES CODE	**The five letter code used to identify the species. Refer to section 4.4. If a species is not listed, then include this information in the 'Comment' for the record.**
DURATION (if cue continuous)	**If the cue is continuous, then indicate the length of time, you were observing this sighting.**
ANIMAL (A) bearing	**Estimated angle of the bow of the ship to the sighting. A sighting dead ahead is 0^o and angles go from 0-360^o.**
SIGHTING DISTANCE	**Estimate of sighting distance in metres?**
GROUP SIZE	**Give the best estimate of group size, including calves. In mixed schools enter the number of each species.**

DUPLICATE SIGHT #	**Duplicate sighting number. This allows duplicate sightings to be cross-referenced.**
DUPLICATE TRIAL	**Indicate if this is a valid duplicate:** **Yes – sighting seen first by MMO** **No – sighting seen first by OT**
DUPLICATE STATUS	**Duplicate status of a sighting:** **D – definite duplicate (at least 90% likely to be the same animal)** **P – possible duplicate (more than 50% likely)** **R – remote change of being a duplicate (less than 50% likely)**
SHIP LATITUDE	
SHIP LONGITUDE	
SHIP (S) BEARING	
RELATIVE MOTION A/S & A'S BEARING	Indicates of the animal is opening away from the ship, closing towards the ship, or moving parallel to the ship's track. "None" if animal is stationary. The heading of the animal relative to the ship should be recorded relative to the line of sight where 0° indicates the animal is heading directly away, 90° indicates the animal is heading from left to right, 180° - directly towards the ship, 270° - heading right to left.
DETECTION SENSOR	Observer who made the sighting: MMO + observer code LO Bridge Acoustic
NUMBER OF CALVES	Enter the number of calves in a group.
SIGHTING CUE	Indicator of cue which led to the sighting: (just use words if more convenient) BL - blow BW – bowride BY - body DV - dive FL – fluke up GL – glint of sunlight off body HS – head slap JU - jump /breach/spin PA – peduncle arch PP – porpoise PS – pectoral fin slap SL- slick, footprint or ring SN – spin SP - splash TS – tail slap WL – seabirds or other associated wildlife OT – other
BEHAVIOUR	BR – Breaching BW – Bow riding FD – Feeding FL - Fluking FS – Flipper slapping ML – Milling

	LO – Logging RE – Resting TR – Travelling TS – Tail slap VO - Vocalizing
END OF TRACK	Reason for stopping a track. BE - sighting behind the beam LO - sighting lost OB - sighting obscured NC - no change of the sighting with respect to the boat (this may happen if the sighting is far away) MA - sighting passed to other LO to follow OT – other
OPERATIONS INFORMATION	Were any mitigation measures implemented?
COMMENT	Any additional information.

4.1.1 Sighting number/Duplicate sighting number

The duplicate sighting number on the sightings form is the number given to the surfacing by the LMMO, and called down to the SMMOs. If the SMMOs think this is the same as a surfacing they sighted, they give write down the LMMOs sighting number under "DUPLICATE SIGHT #" on the form. Two types of duplicate sighting can be distinguished: those that represent valid trials for estimating the OT detection function and those that do not. Valid trials are where the SMMO saw the surfacing independently (for example because they were tracking the group) and then the LMMO radios down to inform the SMMO that a surfacing has been seen by the OT, and the SMMO determines it's the same as the one they just saw. In this scenario, "Yes" should be entered under "DUPLICATE TRIAL". By contrast, trials do not occur when the LMMO alerts the SMMOs to a surfacing that the OT have seen but the SMMOs had not previously seen, and then the SMMOs see the surfacing and record information on it. In this case, although it's a duplicate (because both OT and SMMO saw the surfacing), it is not a valid trial as the OT saw it first directed the SMMO to see it. Hence "No" should be entered under "DUPLICATE TRIAL".

This duplicate information should be recorded by the SMMO since they are making any duplicate assessment. It is not necessary for the LMMO to fill in this information. The LMMO just need to pass sighting numbers of OT sightings to the SMMO so that the SMMO can fill in the duplicate information on their forms.

4.1.2 Multi species sighting

When recording groups of mixed species, record the information on separate lines but assign the same sighting number.

4.1.3 High density regions

It is anticipated that in the region chosen for the survey, animal density will be low. However, if the density of animals is high, so that the assessment of duplicate status becomes difficult, then indicate this on the effort form (see section 4.2). Cross-referencing of duplicates may need to be reconsidered. If density of animals is high (i.e. detections occur more than once every few minutes), then the timing of sightings becomes critical.

4.2 MMO Effort/weather form

This form should be completed by the LMMO every time an 'event' occurs, for example at the start/end of search effort, observer rotation, changes in the weather. If the density of animals is too high to make it difficult to assess duplicate status, then indicate this in the 'Event' field. Sometimes the weather will be too bad for searching, in which there will be no search effort.

FIELD	DESCRIPTION
EFFORT	Whether search effort is ON or OFF.
EVENT	Record the event: 1 – begin search effort 2 – stop search effort 3 – observer rotation 4 – weather change 5 – transect waypoint 6 – high animal density 7 – back to normal animal density 8 – end of day
TIME	Time of event
LATITUDE	
LONGITUDE	
Port MMO	MMO who is searching on port side of vessel.
Starboard MMO	MMO who is searching on starboard of vessel.
LMMO	MMO who is acting as liaison MMO.
DMMO	MMO who is data recorder
SEA STATE	Beaufort Sea state on a scale of 0-7.

Beaufort number	Wind speed kt	km/h	mph	m/s	Mean wind speed (kt / km/h / mph)	Description	Wave height m	ft	Sea conditions	Land conditions
0	0	0	0	0-0.2	0 / 0 / 0	Calm	0	0	Flat.	Calm. Smoke rises vertically.
1	1-3	1-6	1-3	0.3-1.5	02 / 04 / 2	Light air	0.1	0.33	Ripples without crests.	Wind motion visible in smoke.
2	4-6	7-11	4-7	1.6-3.3	05 / 09 / 6	Light breeze	0.2	0.66	Small wavelets. Crests of glassy appearance, not breaking	Wind felt on exposed skin. Leaves rustle.
3	7-10	12-19	8-12	3.4-5.4	9 / 17 / 11	Gentle breeze	0.6	2	Large wavelets. Crests begin to break; scattered whitecaps	Leaves and smaller twigs in constant motion.
4	11-16	20-29	13-18	5.5-7.9	13 / 24 / 15	Moderate breeze	1	3.3	Small waves.	Dust and loose paper raised. Small branches begin to move.
5	17-21	30-39	19-24	8.0-10.7	19 / 35 / 22	Fresh breeze	2	6.6	Moderate (1.2 m) longer waves. Some foam and spray.	Smaller trees sway.
6	22-27	40-50	25-31	10.8-13.8	24 / 44 / 27	Strong breeze	3	9.9	Large waves with foam crests and some spray.	Large branches in motion. Whistling heard in overhead wires. Umbrella use becomes difficult.
7	28-33	51-62	32-38	13.9-17.1	30 / 56 / 35	Near gale	4	13.1	Sea heaps up and foam begins to streak.	Whole trees in motion. Effort to walk against the wind.
8	34-40	63-75	39-46	17.2-20.7	37 / 68 / 42	Gale	5.5	18	Moderately high waves with breaking crests forming spindrift. Streaks of foam.	Twigs broken from trees. Cars veer on road.
9	41-47	76-87	47-54	20.8-24.4	44 / 81 / 50	Strong gale	7	23	High waves (2.75 m) with dense foam. Wave crests start to roll over. Considerable spray.	Light structure damage.
10	48-55	88-102	55-63	24.5-28.4	52 / 96 / 60	Storm	9	29.5	Very high waves. The sea surface is white and there is considerable tumbling. Visibility is reduced.	Trees uprooted. Considerable structural damage.
11	56-63	103-117	64-72	28.5-32.6	60 / 111 / 69	Violent storm	11.5	37.7	Exceptionally high waves.	Widespread structural damage.
12	>63	>117	>72	>32.7	N/A	Hurricane	14+	46+	Huge waves. Air filled with foam and spray. Sea completely white with driving spray. Visibility very greatly reduced.	Massive and widespread damage to structures.

SONAR	Is sonar On or Off?
EXPLOSIVES	Are explosives in use: Yes or No.
VISIBILITY	General impression for spotting marine animals: B – Bad (<0.5km) P – Poor (0.5 – 1.5km) M – Moderate (1.5 – 10km) G – Good (10 - 15km) E – Excellent (<15km)
WAVE HEIGHT	Light (0 – 3ft) Moderate (4 – 6ft) Heavy (>6ft)
SWELL DIRECTION	
WIND DIRECTION	
WIND SPEED	
% GLARE PORT	
% GLARE STARBOARD	
% CLOUD COVER	

4.3 MMO Observer code form

This should be completed at the start of the survey and the observer codes decided. The heights are needed if reticle readings have to be converted to distances.

FIELD	**DESCRIPTION**
CODE	Two letter code for each observer.
NAME OF OBSERVER	Name of the observer
EYE HEIGHT	Eye height (in feet) of the observer (to be used for converting reticle estimates to distances).
PLATFORM HEIGHT	Height of SMMO platform (in feet) above sea level.

4.4 Table of species codes

CODE	**COMMON NAME**	**SCIENTIFIC NAME**
BALMU	Blue whale	*Balaenoptera musculus*
BALPH	Fin whale	*Balaenoptera physalus*
MEGNO	Humpback whale	*Megaptera novaeangliae*
BALAC	Minke whale	*Balaenoptera acutorostrata*
BALED	Bryde's whale	*Balaenoptera edeni*
BALBO	Sei whale	*Balaenoptera borealis*
BAL--	Unidentified rorqual	Balaenopteridae
WHALE	Unidentified whale	
ZIP--	Unidentified beaked whales	Ziphiid
MES--	Unidentified *Mesoplodon*	*Mesoplodon* spp.

MESDE	Blainville's beaked whale	*Mesoplodon densirostris*
ZIPCA	Cuvier's beaked whale	*Ziphius cavirostris*
INDPA	Longman's beaked whale	*Indopacetus pacificus*
PHYMA	Sperm whale	*Physeter macrocephalus*
KOGBR	Pygmy sperm whale	*Kogia breviceps*
KOGSI	Dwarf sperm whale	*Kogia simus*
KOG--	Unidentified pygmy/dwarf sperm whale	*Kogia* spp.
ORCOR	Killer whale	*Orcinus orca*
PSECR	False killer whale	*Pseudorca crassidens*
FERAT	Pygmy killer whale	*Feresa attenuata*
PEPEL	Melon-headed whale	*Peponocephala electra*
GLOMA	Short-finned pilot whale	*Globicephala macrorhynchus*
TURTR	Bottlenose dolphin	*Tursiops truncatus*
STEAT	Pantropical spotted dolphin	*Stenella attenuata*
GRAGR	Risso's dolphin	*Grampus griseus*
STELO	Spinner dolphin	*Stenella longirostris*
STECO	Striped dolphin	*Stenella coeruleoalba*
STEBR	Rough-toothed dolphin	*Steno bredanensis*
LAGHO	Fraser's dolphin	*Lagenodelphis hosei*
DOLPH	Unidentified dolphin	
CET--	Unidentified cetacean	
CHEMY	Green turtle	*Chelonia mydas*
EREIM	Hawksbill turtle	*Eretmochelys imbricata*
DERCO	Leatherback turtle	*Dermochelys coriacea*
CARCA	Loggerhead turtle	*Caretta caretta*
LEPOL	Olive ridley turtle	*Lepidochelys olivacea*
TURTL	Unidentified turtle	
MONSC	Hawaiian monk seal	*Monachus schauinslandi*

5 OTHER ACTIVITIES

5.1 Final cruise report

At the end of the cruise a brief report which contains a general evaluation of the survey (i.e. suitability of vessel, platform locations, search procedure, sighting protocol, equipment, general operation etc.) would be helpful. Perhaps include a summary of the survey data collected (number of miles/km searched, number of sightings of each species) and any problems that have occurred, any adaptations to the protocol that may have been implemented or if any new species codes have been added. This information will be useful to refine survey methods for the next survey and in the analysis of the data. This cruise report should describe the trials that are to be included in the analysis, unambiguously indicating only the trials that should be used. This list of trial numbers would integrate all information contained in the data commentary from the perspective of the observers who collected the data.

5.2 And finally!

Have a good time and enjoy the survey! Don’t forget you can contact the St Andrews team at any time (time difference allowing).

APPENDIX A EQUIPMENT LIST

LO Equipment

Each LO should have the following equipment, which are all provided:

- Compass for measuring sighting angle
- 7x50 binoculars for searching
- Big Eyes for group size
- Headsets or other means of communicating with bridge

MMO Equipment

Each MMO should have the following equipment:

- 7x50 Binoculars with reticles
- Compass (provided on platform)
- GPS or synchronised digital watch
- Radios (handheld or headsets to communicate with other MMO)
- Clipboard
- Pencils
- MMO sighting forms
- MMO effort/weather forms (LMMO only)
- Equipment to communicate with bridge
- Crib sheet for converting reticles to distances
- Crib sheet of species codes.

APPENDIX B LO DATA – DAILY MARINE MAMMAL LOG

The following table describes the data recorded in the LO 'Daily marine mammal log'.

FIELD	DESCRIPTION
A. DTG	Date and time of sighting DDHHMM Z MMM YY
B. Species/Type of mammal	Types are Whale/Dolphin/Porpoise/Seal/Sea lion/Turtle/Generic (i.e. unknown)
C. Number of mammals	Number
D. Calves	Yes/No
E. Initial detection source	Visual/Aural
F. Initial bearing/range	Bearing in degrees (true)/ Range in yards
G. Unit position	Latitude DDMMSS N/S and Longitude DDDMMSS E/W
H. Unit course/speed	Course in degrees (true)/ Speed in knots
I. Last known bearing/range	Bearing in degrees (true)/ Range in yards
J. Total time visually observed	Time in minutes
K. Wave height	Wave height in feet
L. Visibility	Visibility in nautical miles
M. MFAS status	On/Off
N. MFAS action taken	Powerdown -6dB/Powerdown -10dB/Shutdown/None
The following fields are completed if MFAS was transmitting when a mammal was sighted and subsequently powered down/shut down, or course changed.	
O. Duration of action	Minutes
P. Maneuver conducted	Turn STBD/Turn PORT
Q. Degrees of course change	Degrees
R. Range action taken	Range in yards
S. Action impact	Tactical degradation assessment – examples: None Slight - degraded ASW screen integrity when ship manoeuvred to open whales Moderate – lost contract when power reduced Significant – engagement interrupted when MFAS as shutdown
T. Narrative of observation	Examples: Dolphins sighted at 1200yds off port bow, closing on ship. Manoeuvred to confirm bow riding and continued MFAS operations.