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Volunteer Seabirds At Sea Survey Methods

Lewis, M. & Dunn, T.E.

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Summary

Volunteer Seabirds at Sea (VSAS) survey methods

This document is designed as an aide-memoir to those taking part in JNCC's Volunteer Seabirds at Sea (VSAS) survey programme but would also be useful to anyone using a distance sampling method to conduct bird or cetacean surveys. It contains advice on how to conduct a survey using the European Seabirds At Sea (ESAS) method; how to correctly code ESAS data; basic rules of data collection; and answers frequently asked questions.

Contents

1   An introduction to ESAS

The ESAS database was created in 1991 to allow seabirds 'at sea' datasets from around Europe to be combined. It contains over 3 million records of seabirds, cetaceans, pinnipeds, and other marine megafauna from North West European and North Atlantic waters. This makes it one of the largest databases of its kind in the world, with data collected and contributed by the 10 European countries comprising the ESAS partnership. The ESAS partnership maintains ownership of the data but the database itself is managed by JNCC. Naturally, with data being incorporated from many different surveys, a standardised approach to data collection is needed, with a coding system that does not discriminate against non-English speakers (hence the use of EURING numerical codes for bird species rather than BTO codes, for example). The database only includes data collected by accredited ESAS surveyors. In a UK context, these are surveyors who have been assessed by a JNCC accredited ESAS instructor and have met five key standards of data collection.

These are:

- Bird identification
- Visual acuity
- Application of the methods
- Recording stamina
- Navigation

For more details on ESAS training, see:
https://jncc.gov.uk/our-work/offshore-seabird-monitoring-training/

2   Introduction to the VSAS/ESAS Methodology

The ESAS survey method (Tasker *et al*. 1984; Webb & Durink 1992; Camphuysen *et al*. 2004) is designed to enable surveyors to collect several different parameters simultaneously during seabird and cetacean sightings surveys. It can be applied from dedicated vessels as they steam along predefined transects or routes, or from 'vessels of opportunity' such as ferries. The VSAS survey programme has been designed to collect ESAS standard data from such vessels.

The methodology is relatively simple when the complications of correct coding (i.e. the recording of the data) are removed from the explanation. The methodology essentially integrates four recording protocols; one for cetaceans and three for birds, and where and when you make your observation dictates how you will record the data. The recording protocols, which are run concurrently, are used for:

- Birds on the water (that can be further divided into records 'In transect' and 'Not in transect)
- Birds in flight
- Birds in flight in 'snapshot'
- Marine mammals/fish/reptiles

A Windows based application and back-up paper forms have been designed to allow the capture of data pertinent to each protocol in the same place with minimum effort. Instructions for using the application can be found in Appendix 16 and examples of the forms in Appendices 1 - 3 of this document. Recording protocols for each method are covered in sections 3.1 – 3.5.

Data collected by observers using paper forms must have accompanying position (e.g. GPS) data to be useful. Suitably configured shipboard or, more usually, handheld GPS units must be used to record the position of tracks while surveys are being carried out.

The recommended set-up for data collection is a 90-degree angle of view to be selected from bow to beam, based on the side of the vessel that affords the best combined viewing conditions (see Figure 1 below and also section 5.1 for a discussion on viewing conditions). This area is then surveyed by a team of two, with one surveyor observing and verbally relaying data to a second who records the information using the app or onto survey forms, in addition to providing supplementary observations. On longer surveys, the inclusion of a third surveyor is recommended to allow the team to rotate, thus ensuring sufficient rest, meals and comfort breaks can be taken and that the standard of data collected can be maintained. In circumstances where it is only possible to use one observer, they should be sufficiently experienced and take regular breaks so that data quality is not compromised by fatigue.

Direction of travel
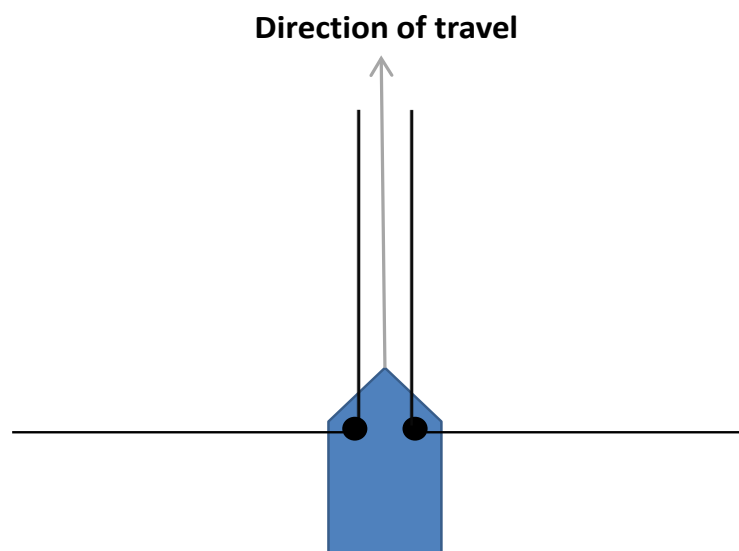
Figure 1. Diagram illustrating recommended viewing angles, where the black circles represent the observer and the black lines the recommended angle of view.

When using paper forms, bird and cetacean observations are recorded in time 'bins' (i.e. a recording period of a given duration – most often one, two, five or ten minutes) and these bins are assigned a position by linking the times recorded by the observers with the time data allocated to the positions recorded by the GPS. The result is that each time bin has a single position and a series of observations associated with it. Without linking observations to the position data, it is impossible to map distributions of observations, or obtain transect lengths, meaning that accurate density estimations are impossible. Therefore, it is vital to ensure spare GPS units and batteries are taken on surveys and that GPS units are correctly configured to collect data (see section 4.3 for how to set up a GPS).

When recording using the app, each observation is automatically assigned a position, so there is no requirement to 'bin' observations as you would if using the paper recording forms.

3   Specific Methodologies

3.1.   Birds on the water

The ESAS method allows collection of data that can be used to derive population densities of birds and is based upon a strip transect model (i.e. sampling birds along a known distance, out to 300m from the vessel – creating a rectangle of known area that has been surveyed – the 'strip transect'). Data within this strip are further divided into predefined distance bands, allowing birds recorded on the water to be assigned to the band they are first seen in. The following distance bands are delineated and applied in the field using a rangefinder as shown in Figure 2:

- Band A – 0 to 50m
- Band B – 50 to 100m
- Band C – 100 to 200m
- Band D – 200 to 300m
- Band E – anything further than 300m
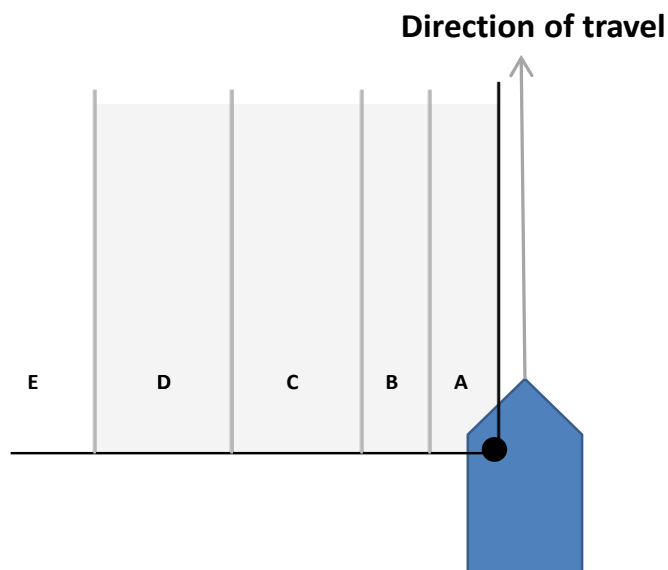
Figure 2. Application of distance bands to the sea surface and delineation of the transect. The area shaded grey is 'the transect'.

Birds recorded in distance bands A – D are 'in transect' and are the data used in analyses to produce density estimates. Birds recorded in band E can be used for mapping distribution and are especially useful for scarcer species. Recording birds in band E can also help observers stay focussed during quiet periods. Note that the transect strip and distance bands stretch ahead of the vessel to the end of the transect line. It is useful to practice placing objects ahead of the vessel in their correct distance bands when seen and not only when perpendicular to the vessel. This should be done with stationary objects (e.g. buoys) as birds will often swim to a different distance band by the time you reach them. This will help you to record accurate distance data at the point observations are first made, which is vitally important to data quality and subsequent analysis.

The use of distance bands allows data to be analysed using 'Distance' analysis methods. 'Distance' acknowledges that the probability of detecting a bird or cetacean decreases with increasing distance from the observer, and models densities within a given area using information on the distance of each record from the transect line. During seabirds at sea surveys, recording accurate distances to individual observations is not possible and distance bands are therefore used.

By using the frequency of records in each distance band, 'Distance' analysis software can model how detection decreases with increasing distance from the transect line. This allows the creation of a 'detection function', which can be used to estimate the proportion of the birds within the strip transect that have not been detected. This method gives more accurate population estimates than a simple strip transect method that assumes all birds are detected. A key assumption of distance sampling is that no animals on the transect line (or in this instance, in the closest distance band – band 'A') are missed. Therefore, it is very important to tailor your scanning routine to maximise detections in band 'A'. The simplest way to achieve this is to include as much forward viewing as possible in your scanning routine; ensure you have selected a suitable platform to observe from (i.e. with clear view of the transect); and that you survey from the side of the vessel with the best environmental conditions. Other extremely important assumptions of Distance sampling are that objects are detected at their initial location (i.e. detected before they have moved in response to the vessel); assignment of observations to distance bands is accurate; and observations are independent (i.e. the detection of one observation is not a result of the detection of another). Further information on Distance sampling can be found here:

http://distancesampling.org/

As correct placement of birds into distance bands is essential for deriving accurate population estimates, steps must be taken to ensure that this action is standardised and that data are accurate. A rangefinder personalised to each observer on each vessel is the simplest way to achieve this.

The rangefinder is used by lining the horizontal top edge (one reason why a wooden ruler makes a good rangefinder) with the horizon, while it is being held at arm's length from the observer. The observer then uses the lines marked on the rangefinder to delineate the different distance bands on the sea surface (see Figure 3 for an example of a rangefinder). Note that the arm's length measurement for the rangefinder can be taken when the arm is held either straight out in front or straight out to the side of the observer. However, the position in which the arm's length measurement is taken must be the position that that rangefinder is used while surveying.

A rangefinder uses an equation that considers the height of eye while observing (above the water level) and the individual observers arm length. Therefore, it is essential that observers make their own individual rangefinder for each different platform they survey from (including different platforms on the same vessel, or if standing/sitting). A spreadsheet that calculates rangefinder increments based upon measurements of eye height and arm length can be found on the JNCC website:

https://hub.jncc.gov.uk/assets/87df030c-5e10-4b05-b2e3-28133e80961c

The increments derived from the spreadsheet are then marked onto the rangefinder as accurately as possible, with the distance bands marked starting with band E at the top and A towards the bottom end, as shown in Figure 3.
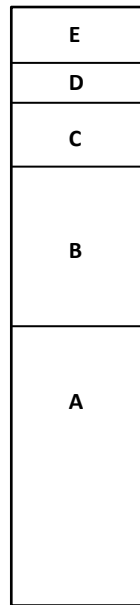
Figure 3. A typical rangefinder.

The rangefinder should only be used where a true horizon is available (i.e. not towards land). Accuracy of the distance bands delineated by the rangefinder is most affected by variations in the height of eye.

3.1.1 Recording birds on the water

Below is an example of data collected on a standard JNCC ESAS observation sheet for birds recorded on the water during a survey. The app records most of the parameters shown here but the recording fields are arranged in order to prioritise recording of the most important data (i.e. the fields coloured grey on the example below). The key differences are the removal of the time field (as position is automatically collected with each observation); the inclusion of individual buttons to record birds from 1 to 9 in number; and a free text field for numbers of birds of ten or over. This allows rapid recording of nine or fewer birds. With the app, behaviours are recorded within a dedicated behaviour field rather as opposed to the NOTES column of the datasheet.

The example below illustrates the following points:

- Time in 'bins' (5 minutes in this example)
- Species in 'SPECIES' column
- Age of individual(s) in 'AGE' column
- Plumage in 'PLU' column
- Number of individuals in 'NUM' column
- Appropriate distance band (measured using rangefinder) in 'DIST' column
- All birds first observed on the water get a tick in the 'SEA' column
- Any records on the water in bands A-D are recorded in transect i.e. get a tick in 'TR'
- For periods/time bins where no birds are seen, record as NO BIRDS and place a tick in 'TR' (the tick is very important for subsequent data checking) – as no time bins are used with the app, this is not required
- Record any relevant behaviour in the 'NOTES' column

	TIME	SPECIES	AGE	PLU	NUM	DIST	DIRN	FLY	SEA	PREY	TR	NOTES
1	09:00	GU		W	3	A			✓		✓	
2		F.		LL	1	C			✓		✓	
3	09:05	GB	A		2	E			✓			
4		GU/RA		8	14	D			✓		✓	Pursuit dived
5		GX	1		2	B			✓		✓	
6	09:10	NO BIRDS									✓	
7	09:15	NX	J		1	C			✓		✓	
8		KI	A	W	1	A			✓		✓	

Figure 4. Example records of birds observed on the water.

Specific ageing and plumage coding protocols are detailed in Appendices 9 and 11.

3.2. Birds in flight

Birds first observed in flight within the 90-degree survey area should be routinely recorded, unless they are associating with the survey vessel. These observations are not placed into distance bands as birds on the water and should be recorded as 'F' in the 'Dist' field/column of the data sheet. As well as the usual parameters such as species and number, the direction of flight (i.e. the true direction, not the direction in relation to the observer) is recorded when possible, as well as any behaviour, especially feeding activity. See Figure 6. below for an example of how to record flying birds.

Only birds in flight recorded in snapshot (see section 3.3) are used to calculate density estimates, as they are the only ones 'in transect'. However, there is value in routinely recording all birds in flight, as these data contribute to our understanding of distribution, feeding associations and foraging ranges (e.g. flying birds seen carrying fish), as well as keeping observers occupied and therefore alert. It is also very helpful to be aware of, and record, flying birds throughout the survey in order to determine if they are in snapshot at the required time. In both recording formats, the recording of snapshot data is set up to be a very simple addition to the routine recording of birds in flight.

3.2.1 Birds in snapshot

The snapshot dataset is comprised of a series of instantaneous counts that can be used to derive the total number of birds in flight in a given area (i.e. a density of birds in flight) at a given time (as opposed to for the whole survey period). Birds are recorded in snapshot if they are in flight at any height, within a defined box at a given 'instantaneous' count time (a 300m x 300m box is most frequently used). The aim is to instantaneously count birds in flight in a series of abutting boxes which correspond to the same area covered by bands A – D for birds on the water. Count timing is defined by vessel speed and the easiest way to manage snapshot counts is by using a stopwatch with an alarm set to go off at regular intervals, according to vessel speed. As the vessel passes along the survey route at a reasonably constant speed, the series of abutting boxes will be formed by the sequence of alarm-prompted 300m x 300m counts. See Figure 5 for further clarification.
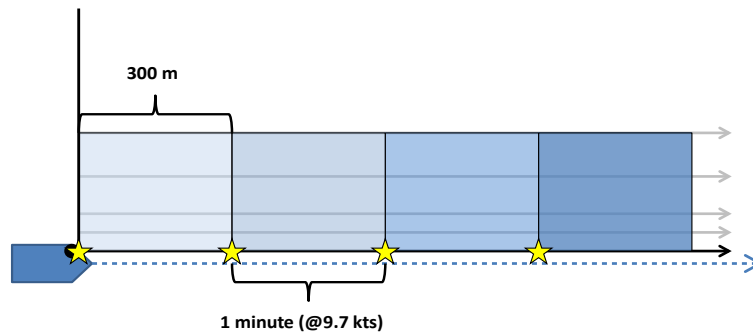
Figure 5. Illustration of the snapshot count method. As the vessel passes along the survey route at a reasonably constant speed, a stopwatch alarm can be used to prompt the snapshot counts every 300m. As the vessel moves from left to right along the route, the snapshot counts (carried out at the locations indicated by yellow stars) cover the blocks in a sequence of lightest to darkest, giving total coverage of the same area covered for birds on the water. The grey lines indicate the distance bands – note how the boundary of the snapshot area parallel to the survey route is defined by the boundary between bands D and E.

The snapshot alarm must be turned on at the instant the survey commences, with a snapshot count being carried out immediately. It is recommended that the instantaneous count is carried out at the end of a series of countdown alarm sounds, giving the observer sufficient time to look around (and above) and fully assess the number of flying birds in the recording area.

Snapshot data do not need to be recorded separately on the app or datasheet. As flying birds are routinely recorded, noting that a particular bird was in a snapshot is as simple as checking the 'In' box in the Transect section of the app display, or placing a tick in the 'transect' column of the datasheet for that record (see Figure 6 for an illustration). Observations of birds in snapshots do not need to be related to specific individual snapshot counts.

If the survey vessel changes speed during a survey, the snapshot time interval must be adjusted accordingly. The recommended method is to maintain the 300m x 300m snapshot area and to change the frequency of the count interval (e.g. if the vessel speeds up, counts will be conducted with increasing frequency and, if it slows down, with decreasing frequency). Alternatively, the size of the snapshot box can be changed, and the frequency of counts maintained. Changing the count frequency is recommended, as observers will become adept at defining a 300m x 300m box and can use their rangefinders to calibrate their snapshot area. See Appendix 5 for details of how to alter snapshot frequencies or areas.

As well as providing a suitable proxy for counting all birds in flight in the whole strip transect at one given time, snapshot counts eliminate biases that might occur as a result of large-scale bird movements in a particular direction. A common misconception is that the snapshot eliminates double counting of birds - this is not the case.

3.2.2   Recording birds in flight and in snapshot

Figure 6 provides an example of data collected on a standard JNCC ESAS datasheet for birds recorded in flight, including those within snapshot, during a survey. For information on how the app screen differs from this datasheet, see section in 3.1.1.

The following points are illustrated:

- Flying birds get an 'F' in the 'DIST' column
- Flying birds get a tick in the 'FLY' column
- Flying birds recorded in snapshot receive an additional tick in the 'TR' column
- Flying birds get a direction of flight, as an 8-point compass point or 1 for 'no discernible direction'
- 'No birds' must be recorded if appropriate, with a tick in the 'TR' column
- Lines 5 and 6 represent 2 guillemots flying together. They are recorded on different lines to differentiate their different plumages. The bracket in the notes column indicates that they are associated. Separation of associated individuals can also be recorded when they differ in other attributes such as age, or behaviour

	TIME	SPECIES	AGE	PLU	NUM	DIST	DIRN	FLY	SEA	PREY	TR	NOTES
1	10:00	KI	J		1	F	W	✓				
2	10:05	F.		LL	2	F	NW	✓			✓	
3		GX	A	6	6	F	S	✓				
4		MX			1	F	1	✓				
5		GU		B	1	F	W	✓			✓	}
6		GU		W	1	F	W	✓			✓	}
7	10:10	NO BIRDS									✓	
8	10:15	OT			1	F	SW	✓				

Figure 6. Example records of birds observed in flight and in snapshot.
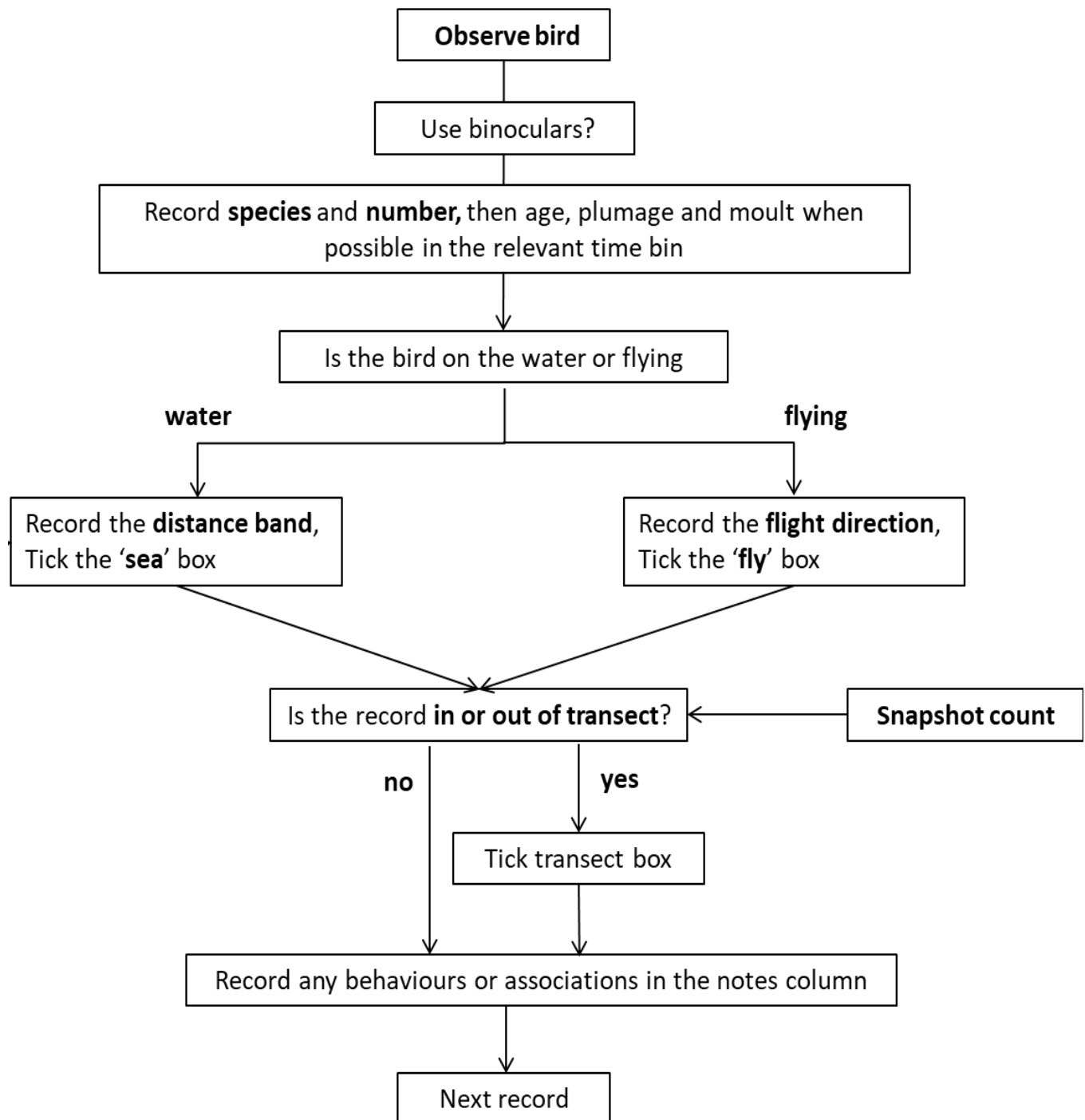
Figure 7. Aide memoir for correct recording of birds on the observation sheet.

3.3. Marine mammals and other fauna

Cetaceans, seals and other fauna (e.g. basking sharks, sunfish, *etc.*) can be recorded using the parameters described for collecting bird data (i.e. species, number, distance band, direction of travel, *etc.*). However, to allow for more accurate Distance sampling (and therefore population estimation), a range and bearing should be taken at the time of first sighting for each marine mammal, turtle, shark, sunfish, *etc.* observation, as these data can be used to calculate the distance of the observation from the transect line. These data suit Distance analyses better than the more 'clumped' data collected for birds. Angle boards and rangefinders can be used to increase the accuracy of these data. Note that the bearing

should be taken from the transect line, rather than taking an absolute bearing. See Figure 8 for an illustration of the additional parameters to be recorded.
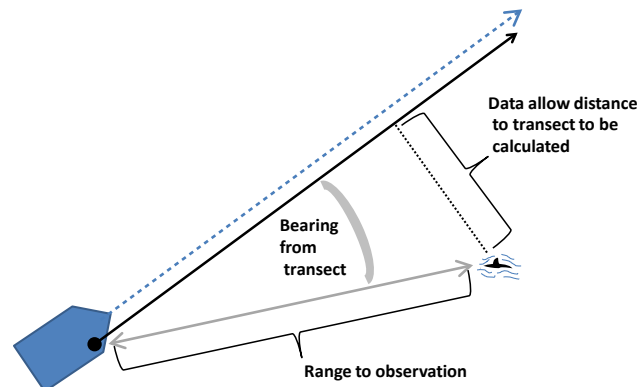
Figure 8. Illustration of the additional parameters to be recorded for marine mammals, sharks, sunfish, and turtles.

3.3.1   Recording data for marine mammals and other fauna

Below are examples of data collected on a standard JNCC observation sheet for cetaceans during an ESAS survey. When using the app, marine mammal data are recorded on a separate page specifically designed for these data, with dedicated fields for range and bearing.

The example illustrates the following points:

- Where appropriate, record the same details as birds on the water (distance bands) but only include direction of travel if one can be discerned.
- Record anything in bands A-D as in transect (as for birds on the water) and note that additional distance bands are available for cetacean sightings - see Appendix 6.
- Bracket associated records together in the notes column, as with bird data.
- Record range and bearing for each record in the notes column.

	TIME	SPECIES	AGE	PLU	NUM	DIST	DIRN	FLY	SEA	PREY	TR	NOTES
1	11:00	MINKE			1	E	W		✓			750m, 35°
2	11:05	WBDOLPH	A		3	D	SE		✓		✓	350m, 12°
3		WBDOLPH	1		2	D	SE		✓		✓	350m, 12°

Figure 9. Example records of marine mammals.

3.4.   Combining the full suite of recording protocols

When on survey, you will be recording birds on the water, birds in flight, birds in snapshot, and other megafauna concurrently. The methods used for each of the above are similar, in that targets must be detected during routine scanning by the observer(s). The observations are then relayed to the scribe who records them on the same datasheet. Your datasheet should look something like the example given in Figure 10 below, which illustrates the following points:

- A time bin can have any number of records associated with it.

- If you don't know the BTO code, use an appropriate abbreviation or a full name – beware of over abbreviating as this can lead to subsequent confusion or errors. Note that app users do not need to be concerned with this, as the app presents species names to choose from.
- Uncertain identifications can be appropriately named e.g. record 15 indicates that the birds were either guillemots or razorbills but definitely not puffins, black guillemots or little auks. If, for example, puffin was a possibility the entry 'Auk' would be more appropriate.
- Use the notes column to record behaviours observed and associations.

Note that if recording using the app, all bird recording protocols are combined within one page, with marine mammals and other megafauna being recorded on a separate page to facilitate recording the slightly different parameters required (i.e. range and bearing).

	TIME	SPECIES	AGE	PLU	NUM	DIST	DIRN	FLY	SEA	PREY	TR	NOTES
1	08:00	NO BIRDS									✓	
2	08:05	KI	A	B	2	F	N	✓				
3		RA		W	1	A			✓		✓	escape dive
4	08:10	GX	I	4	1	F	SE	✓				
5		GX	I	2	1	F	SE	✓				
6		F.		LL	2	E			✓			
7		HPORP			3	C	NW		✓		✓	450m, 27°
8	08:15	GU		B	1	B			✓		✓	
9		LB	A		1	F	S	✓			✓	
10	08:20	KI	J		4	F	NW	✓				
11		AE	A	B	7	B			✓		✓	
12		PU	I		1	D			✓		✓	
13		LTSKUA	A		1	F	E	✓				
14		HG	A		3	C			✓		✓	
15		GU/RA		8	24	F	N	✓			✓	

Figure 10. Example records from all four recording protocols on the same data sheet.

4. Some basic rules

The exact recording protocol for any vessel-based survey (e.g. VSAS, ESAS, industry survey, *etc*.) should be made clear prior to commencing the work. These include details such as scan angle, time bin length and the number of observers. There are, however, a few rules that should be standard across all protocols.

4.1 Identification

Birds, cetaceans and other megafauna should be identified to species level where possible. However, if there is uncertainty with an identification, the observation should be recorded to the lowest possible level. It is not unusual to see records such as GU/RA (guillemot or razorbill) or 'large gull spp'. Records such as these are more valuable than incorrectly 'guessed' identifications (suspected identifications can be recorded in the notes column). The same is true for ageing birds and false precision from incorrectly ageing birds to

calendar years should be avoided. If the age of a bird is not clear, it can be left unaged (U), coded simply as an immature (I), or as 'not an adult' (N). Of course, observers should be sufficiently skilled to be able to identify the majority of sightings to species level.

4.2   Use of binoculars

Birds, cetaceans and other megafauna should be detected with the naked eye and binoculars only used to aid or confirm identification. The only exception is on surveys in areas where there are bird species that demonstrate high levels of vessel avoidance (e.g. some seaduck and diver species). In these areas, binoculars can be used to scan forward to detect these species before they are flushed by the vessel, although the standard protocol should still be applied to all other species and the alteration noted on the trip sheet (also see Section 6). Unstandardised use of binoculars means that the ability to detect birds in further distance bands will be improved but the change in 'effort' will not be recorded. This leads to inaccuracies during analysis and ultimately less accurate population and density estimates.

4.3   Scanning

An observer's scanning routine should be as methodical as possible, with distance bands closer to the transect line being given higher priority than more distant ones. This is because population estimates derived from this type of data rely on the assumption that detection on the transect line (in this instance, distance band A is a proxy for the transect line) is 100% of the birds available.

4.4   Ship associates

The aim of an ESAS survey is to record natural populations and distributions of birds and cetaceans. This is often complicated by the fact that some bird and cetacean species are attracted to vessels and others actively avoid them. Birds and cetaceans that are deemed to be associating with the survey vessel should not be recorded, even if they subsequently leave the vicinity of the vessel. Birds and cetaceans that are deemed to have approached the vessel should be coded accordingly (see Appendix 6). There are also codes for birds and cetaceans observed to 'escape dive' or 'escape fly' in reaction to the vessel.

4.5   Transect line

The transect line runs through the observer and not the centre of the vessel. This ensures that there is no width added to the transect when an observer is situated away from the centre line of the vessel (especially on wide beam vessels such as ferries) and allows the observer to accurately determine which sightings are within the transect.

4.6   Changing sides

If environmental conditions change, and conditions are more suitable on the other side of the vessel, you can change sides. You do not need to record that you have changed sides and there is nowhere to record this on the data sheets. In theory, you can change sides as many times as is necessary although, when changing, you should attempt to do so as quickly as possible.

4.7   A bird survey is not an endurance test

Observer fatigue almost certainly has a detrimental effect on data quality and it's natural for observers to become tired through the course of a day's surveying. The best way to combat

this is by having enough surveyors to allow regular breaks to be taken, although in some situations this is not possible. Maintaining data quality should always be the survey teams' primary objective so, if an observer is feeling fatigued, they should acknowledge this and try to do something about it. This could be something as simple as rehydrating or drinking a coffee. Roles can also be swapped, with a fatigued observer taking on a scribe's role, or a refreshed observer on a break stepping in. If roles are swapped to combat fatigue, this must be recorded with a new trip key (see Section 6 for more info. on recording trip data).

5. Starting to survey

5.1 Conditions suitable for survey

Data should not be collected in conditions that would excessively restrict bird detection. There are several environmental factors that need to be assessed both before a survey begins and periodically while on survey. Some of these have specific guidance and others require surveyors to make a judgement. ESAS guidelines state that surveys should not be carried out in a sea state of six or above (see Appendix 7). Other factors must also be considered in combination when deciding if surveying is acceptable. These include:

- Light levels – recording in low light, e.g. too early in the morning or late in the evening, could reduce detections.
- Precipitation – heavy rain or snow will reduce an observer's ability to detect and identify birds and cetaceans.
- Glare – strong glare in the transect will reduce detections, contribute to observer fatigue and could lead to eye damage.
- Visibility – this needs to be completely unhindered to 300m at the very least, and ideally with a visible true horizon.

In addition, other factors should be assessed when deciding which side of the vessel to survey from. These include:

- Wind direction - observing while looking into the wind is uncomfortable and can cause eyes to water, which distracts observers and could hinder detection.
- Direction of wave movement – observing along the troughs between waves should give you more chance of detecting targets than looking across the tops of the waves.
- Sea colour – be aware of how the sea may appear to be a different colour on each side of the vessel, and how this can affect your detection ability. Most detection is triggered by movement or contrast, therefore, consider the species you are likely to encounter, the light conditions, and how much contrast the birds are likely to have with the sea surface. In bright sunlight, white plumage often 'flares' making birds with white plumage more obvious on a dark sea. In overcast conditions, dark plumage contrasts more against a pale grey sea.

5.2 Preparing for a survey

Before starting a survey, make sure to check the following:

- Is there a safe and appropriately high place (above 5m) to observe from?
- Is the weather suitable to collect data (see above)?
- Is the vessel steaming at a suitable survey speed (ideally between 5 – 15kts)?
- Do I have sufficient protection from the elements?
- Do I have everything I need with me?
  - Binoculars

- o Datasheets or Tablet with App
- o Pens/pencils and spares
- o GPS and backup GPS
- o Spare batteries
- o Rangefinder
- o Snapshot timer and backup timer
- o VSAS manual and plumage guides
- o Angleboard

5.3   GPS use

Remember to turn on the GPS units well before the start of a survey (any superfluous position data can be removed later) as they can sometimes take several minutes to connect to enough satellites to start collecting position data. This is especially the case if you are moving a large distance between cruises, in which case it is often worth putting the GPS on to get a position the night before sailing. GPS units work best when they have an unobstructed 'view' of the sky. They are robust to the weather, but it is sensible to give them some protection.

Setting up a GPS to collect suitable position data is crucial, so it's important to check the configuration of the GPS (and back-up GPS) before a survey commences. The following steps refer to setting up a Garmin Etrex GPS and other makes and models may differ slightly.

The GPS needs to record the track that the survey vessel takes. To ensure this is done correctly, in the 'Track' options check that:

- Track log is 'On'
- There is sufficient memory on the unit to record the tracks (older GPS units are able to store 15 – 20 long days' worth of tracks. Newer ones probably more)
- 'Wrap when full' is checked in 'Log setup'
- Record method is set to 'Time'
- The recording interval is appropriate – i.e. 30 seconds to 1 minute for vessel-based surveys

You also need to ensure the GPS is recording in the correct units. In the 'Setup' menu check:

- Time
    - o 'Time format' is 24 hours
    - o 'Time zone' is London
    - o 'UTC offset' is 00hh 00mm
    - o 'Daylight saving time' is set to 'No'
- Units
    - o 'Positions format' is set to hddd.mm.mmm
    - o 'Map Datum' is set to WGS84
    - o 'Heading'
    - o 'Display' is set to 'degrees'
    - o 'North reference' is 'True'

Most commercial surveys will have some sort of communication between the bridge and the observation area to alert observers to the start and end points of transects. Make sure you know what form this communication will take and, if radios are being used, test them. Be

aware that surveys should only commence once the vessel's cruising speed has been reached.

5.4   Snapshot timers

A variety of devices can be used to alert observers that a snapshot count is required, e.g. digital watches, or apps on mobile phones. As such, it is not possible to give full instructions for setting devices up appropriately, but there are some requirements that will be common to all devices.

- The alarm must be loud enough to be heard while surveying (surveyors often strap digital watches on.to their binoculars or tuck them into woolly hats to ensure that they can be heard).
- All devices must be able to run a repeat countdown timer with an alarm, i.e. a timer that sounds an alarm at the end of each countdown, and then automatically resets and begins another countdown.
- The more weatherproof a device is, the better.
- All devices must have sufficient battery life to cover a full survey and it is advisable to take a backup device and spare batteries.

6.   Coding protocols

When carrying out a survey you will be entering data onto the app, or if for some reason this is not possible, a minimum of two data sheets. The basic structures of the app and paper-based data collection are very similar. The 'Trip' page/sheet is used to record details of each trip key and environmental data. The 'Observations pages/sheet' is where data for sightings are recorded. If you are not recording using the app, you can also collect data on your position as a backup to those recorded directly onto your GPS; this will be on a separate sheet (see Appendix 3) where you should aim to record a position regularly (e.g. at least every 30 minutes) from your GPS. Running a GPS and a second as back-up will usually suffice, although having a paper backup is still advisable. The vessel should also have a record of positions and this can usually be requested if necessary. To ensure position data are being recorded properly, it is advisable to download them from your GPS at the end of each day. These data can then be plotted in GIS software to make sure the survey tracks look like they should and there are no data missing. Save the file and back it up each day to an external device (e.g. a USB drive) in case of hardware or software malfunction.

6.1   Trip sheet/page (also see Appendix 1)

On the app, trip details are recorded by tapping the boat icon (available in the recording windows menu, selected by tapping the full colour icon in the menu bar). Data fields and recording are as described below for paper-based data entry. For those recording on paper there are two boxes on the trip sheet, one for trip key data and one for environmental data. In the trip key box, a row should be filled in at the beginning of each new transect and whenever there is a change of observers or their roles; a change in base activity; or method. Trip keys are vitally important, as they link position and environmental data to observation data. Therefore, it is of paramount importance to record trip keys correctly and sequentially throughout the whole trip.

6.2   Trip data

In addition to recording the survey date and base/vessel name from which you are surveying, the following data must be recorded for each new trip key: An example of how to fill in the Trip data fields can be seen in Figure 11.

Trip key
Starts with '1', then continues sequentially for each new trip key (i.e. 1, 2, 3, *etc*.)

Base activity
What the boat is doing while you are collecting data. On VSAS ferry surveys, this will always be 'steaming'. On industry surveys code 1 is often used (i.e. non-fishing activity). On other vessels it could be 'steaming' as data may be collected while boats are travelling between sampling stations or engaged in, for example, seismic surveys.

Eye height
The height of eye while recording data. Use the codes defined in Appendix 6.

Remember though that it is important to have an accurate measure of your height of eye for inputting into the rangefinder formula, and that eye height can change significantly between standing and sitting positions or between different platforms within the same vessel.

Scan angle
For VSAS surveys this will be 90 degrees bow to beam (code 8). Observers carrying out a 90-degree scan can change sides as frequently as they deem necessary, as viewing conditions change through the day. You do not need to note which side of the vessel you are surveying from or enter a new trip key when you change side.

Trans width
This will be 300 metres for a standard VSAS survey and for the majority of other surveys.

Species counted
This will be 'all' (code 1) unless you are surveying for specific species or are overwhelmed by certain species associating with the vessel e.g. fulmar. There are codes in Appendix 6 for when certain species are not recorded. If it is decided to stop recording a species, start a new trip key and make sure the relevant code is entered. When you return to counting all species, change the trip key again and record the species seen accordingly. Note that this should only happen in very exceptional circumstances. All species (code 1) refers to all seabird species (true seabirds, divers, grebes and seaduck – for seaduck read scaup, all eiders, scoter, long-tailed duck, red-breasted merganser, goosander and goldeneye). Some industry surveys will require collection of data on migrant birds such as waterfowl, waders and migrant passerines.

Duration (mins)
This is only necessary for paper-based data recording as the app assigns locations to every observation. Therefore, proxy locations derived from time bins are not necessary. For VSAS surveys where data is being recorded on paper, use a bin duration of two minutes. ESAS surveys 'bin' observations into time periods, so the 'duration' is the number of minutes that each observation period lasts. For industry surveys, this is often one minute as this gives much finer scale distribution data. Other surveys may operate with bins of five or ten minutes. Note that this is not to be confused with the snapshot times. Standard ESAS surveys usually use either one minute or five minute bins although, in the deep sea, where bird distributions are very sparse, 10 minutes may be more appropriate.

Observer(s)
If using the app, record both sets of initials with the primary observer's initials first. If using paper, put the initials of both people on watch and circle the primary observer (i.e. the observer not engaged in scribing duties).

No. obs
For each 90-degree scan this would be recorded as two, assuming that data are being collected by one observer and one scribe recording data exclusively over one 90-degree arc.

TRIP KEY	TIME	BASE ACTIVITY	SCAN ANGLE	TRANS WIDTH	SPECIES COUNTED	DURATION (mins)	OBSERVER(S)	NO. OBS	NOTES
1	07:10	steam	90	300	All	2	(ML) TD	2	
2	08:10	steam	90	300	All	2	(TD) DT	2	
3	08:37	steam	90	300	All	2	(DT) ML	2	new transect
4	09:37	steam	90	300	All	2	(ML) TD	2	
5	10:15	steam	90	300	All	2	(TD) ML	2	change obs (fatigue)
6	11:15	steam	90	300	All	2	(TD) DT	2	

Figure 11. Example of trip data. Note the sequence of Trip Keys from one to six, reflecting changes in observers (due to team rotation, and single changes due to observer fatigue and a change in transect). The time of each change is noted in the time column. During most surveys, the vessel activity, scan angle, transect width, species counted and duration (i.e. the length in time of each time bin) will not change. Those using the app will notice that there are no fields for time or duration. On the app, the time of each change in trip key is filled in by the tablet, and the 'duration' is not needed as each observation is given a position so, therefore, does not need the proxy position as defined by a time bin.

6.3   Environmental data

On the app, environmental details are recorded by tapping the boat icon (available in the recording windows menu, selected by tapping the full colour icon in the menu bar). Data fields and recording are as described below for paper-based data entry. For those recording on paper, the bottom half of the trip data sheet is for environmental data. This should be entered at the beginning of each transect and updated whenever there is significant change in weather conditions. It is often helpful to record at set intervals (e.g. 30 minutes) in order to remember to record. An example of how to fill in the Environmental data fields can be seen in Figure 13.

The following data need to be recorded:

Wind force
Use Beaufort scale. See Appendix 7

Sea state
Use Beaufort scale. See Appendix 7

Swell height
As it's very difficult to estimate actual swell height, a nominal scale of Low (less than 2m), Moderate (2 to 4m) and High (>4m) is used.

Visibility
Use a nominal scale of Excellent (≥10km), Good (>5km), Moderate (1 – 5km), Poor (<1km).

Cloud
The amount of cloud covering the sky is expressed in eighths or Oktas, i.e. a cloudless day would be 0 and a fully overcast day would be 8.
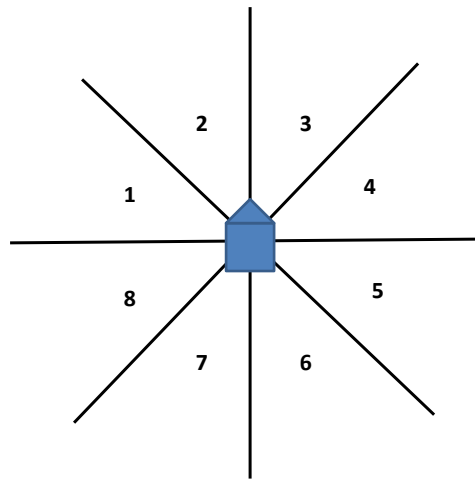
Rain
Recorded as none, strong, moderate, light, continuous or intermittent.

Sun strength
Recorded as none, weak, moderate or strong.

Sun direction
Sun direction is measured relative to the observer, rather than an actual compass direction. Divide your 360 degree field of view into eight equal sectors. Starting directly abeam to the port side and moving clockwise, these eight sectors are numbered 1 to 8 (see below). The sun direction is the number of the sector that the sun is in.

Figure 12. Diagram showing sectors for recording sun direction.

TIME (GMT)	WIND DIRN	WIND FORCE (B'fort)	SEA STATE	SWELL HEIGHT	VISIBILITY	CLOUD (Oktas)	RAIN	SUN STRENGTH	SUN DIRN	NOTES
07:10	SE	4	3	low	exc	5	none	mod	6	
07:35	SE	5	3	low	exc	5	none	mod	6	
07:45	SE	5	4	low	exc	5	none	mod	6	
08:37	SE	4	4	low	exc	6	none	mod	4	
08:55	SE	4	4	low	exc	8	none	none	4	
09:08	SE	4	4	low	good	8	mod	none	4	
09:41	SE	4	4	low	good	7	none	none	4	
10:03	S	3	4	low	good	7	none	none	4	

Figure 13. Example of Environmental data. Note that each time a recordable change in environmental conditions is observed (e.g. an increase or decrease in wind force or sea state, change in cloud cover, or precipitation) it is noted as a new line of data on the app page/sheet, with the time associated with the change.

6.4   Navigation sheet (also see Appendix 3)

There is no space for recording a navigation back-up on the app, as the tablet and GPS units supplied should provide sufficient back-up of navigation data. With paper-based recording, the navigation sheet provides a useful back-up to log positions if there are issues with the electronic recording of tracks. Common practice is to record a position at the start and end points of transects/periods of survey and to record a location every 30 minutes during the survey.

Time	St/ Mid	Latitude	N/S	Longitude	E/W	Course	Speed
07:10	S	57°08'39.6	N	2°03'34.4	W	45	10
07:30	M	57°14'04.6	N	1°49'09.9	W	35	10
08:00	M	57°28'38.1	N	1°24'19.8	W	90	10
08:30	M	57°29'37.3	N	0°54'22.7	W	180	10
08:40	E	57°28'29.1	N	0°54'22.0	W	180	10

Figure 14. Example of Navigation data. Note how the start and end points are recorded in the St/Mid column (points labelled with 'M' are mid points – not necessarily at the actual midpoint of a transect but collected at any point between a start and an end). Course is recorded in degrees and speed in knots.

6.5   Observation sheet (also see Appendix 2)

This is the sheet where all bird, cetacean and other megafauna observation data are recorded and, until the data are transcribed and quality controlled, they should be kept safe.

Time
This is not required when using the app, as proxies for positions are not required. With paper-based data recording, observations are 'binned' into time periods that should be made clear before the start of the survey. The time should be noted at the beginning of the bin, even if no birds are recorded, and there is no limit to how many records can be placed in each bin. For bins where no birds are recorded at all (either in or out of transect), it is useful to write 'NB', 'No Birds' or similar in the species column, and to tick the transect box, i.e. to record that 'No birds' were 'in transect'.

Species
When recording using the app, species are selected from menus of common, less common, scarce, rare and 'uncertain' birds. These are selected by tapping the relevant button, so there is no requirement to type any free text or remember any species codes. If recording on paper, for the sake of simplicity and consistency with what most other surveyors use, use the two letter BTO codes for the species in this column if you know them. When entering data into the database you will need to input the relevant EURING code (a numerical code – see Appendix 6 again).

If you can't identify the bird to species, be as accurate and precise as possible. It's fine to record 'Gull spp', 'Auk spp', *etc*. Recording data under 'Auk spp' is preferable to a miss-identified auk.

Age, **Plumage and Moult**
These have been lumped together here as the three are often confused. Different groups of birds have different ageing conventions, so the applicable ages, plumages and moults are outlined below by species group.

Actual ages are recorded in the 'age' column, such as A, I, J, or for those that can be assigned to a calendar year, the relevant number.

Plumages are recorded in the plumage column. Phases such as L, I or D, seasonal such as B or W, or sexual such as M or F

Unless there are specific codes for a species, it is recommended that birds are aged by calendar year where possible. Experienced birders use terminology such as 1st winter, 2nd summer, *etc.*, but there are a few issues with using these for ESAS.

For gulls, differentiating between juvenile and 1st winter plumages on survey will potentially be both difficult and time consuming. Some more northern gulls retain a complete set of first-generation feathers beyond December, officially still juvenile plumage, but observers generally don't have the time or the high-powered optics to check this. Use of the calendar ESAS year system (June 1st to May 31st.) eliminates this issue.

This means that a gull hatched in the 2012 breeding season will be in its first year (recorded as 'J') until May 31st 2013. From June 1st 2013 until May 31st 2014 it will be in its second year (recorded as '2') and so on until it reaches its adulthood. Adult birds are recorded with an 'A' in the age column, and birds that are not adult that cannot be aged any more specifically are recorded as Immature (coded as 'I').

Please only use these codes and ageing conventions when ageing/assigning birds a plumage.

Gannet

See Appendix 4 on gannet and fulmar plumages for the correct application of these codes

Age	Plumage
J	1
I	2
I	3
I	4
I	5
A	6

Note that the numbers recorded as plumages do not directly correspond to the age, in years, of the gannet. Individual birds progress towards adult plumage at different rates, so the numbers refer to the state of the plumage rather than the age.

Fulmar

Fulmars cannot be aged in the field (ensure a 'U' is entered into the age column), but the plumage phase should be recorded (LL, L, D or DD – see the Appendix 4).

Seaduck

Ageing and sexing of seaduck can be complex. Age using calendar years as indicated above where possible and use codes for male and female birds in the plumage column on the datasheet (these codes go into a separate 'sex' column when data are entered into the database).

Divers

Divers can be aged as 1st or 2nd calendar year, or breeding, winter or transitional plumage. These seasonal plumages are recorded in the 'moult' column. A bird in breeding plumage is not necessarily an adult.

Skuas

'Small' skuas show light, intermediate or dark phases…record these in the plumage column with L, I or D.

Most can also be aged. Record as 1st calendar year, immature (or second/third calendar year if you're confident) and adult.

Great skuas have a distinct juvenile plumage but other than that the age should not be recorded.

Gulls

Use calendar years and only record breeding or winter in the plumage column for adult birds or birds for which you are certain that breeding or winter plumage characteristics are visible. The ages available for each species are outlined below: If you're not sure of the birds' calendar year, but it is not an adult, record it as 'I' in the age column.

Kittiwake, Black headed, little, common gulls – 1st yr, 2nd yr breeding, 2nd yr winter, adult breeding, adult winter.
Herring/lesser/greater bb – 1st yr, 2nd yr, 3rd yr, 4th yr, adult breeding, adult winter.

Terns

Terns can be recorded as 1st or 2nd calendar year, adult breeding or adult winter.

Auks

Most auks cannot be aged unless they are clearly juvenile.

Auks can show breeding, winter, and transitional plumages. These should be recorded in the moult column. For ease of recording flocks of auks that contain a variety of different moults during busy periods, a code for 'mixed moults' (code as 8) can be used. Note that this is not to be confused with individual birds showing a mixture of breeding and winter plumage. These birds are coded as transitional.

Puffins show four distinct plumages. Juvenile, immature, breeding, and winter.

Do not age or record any plumage for shearwaters or petrels. You can record whether there is visible wing moult for these species (and for any others should it be observed) which can be used to infer age in some circumstances.

Number
The number of birds per observation.

Distance
This is the distance band assigned to birds recorded on the water; A (0-50m), B (50-100m), C (100-200m), D (200-300m), or E (>300m). There are also further distance codes for cetaceans, S (300 – 500m) and T (500 – 1000m). Code W is retained as a catch all for

records of animals on the water 'in transect' but should be used rarely and only under extreme pressure. When inputting the data, 'F' should be used in this column for flying birds.

Direction
The direction of flight or an association code is entered into this column. Numerical codes can also be used for directions.

When a vessel is not steaming a direct North/South or East/West transect, working out a flight direction can be problematic. It can be helpful in these circumstances to use an angle board or even to draw a crude compass on the datasheets.

Fly and **Sea**
These are tick boxes. Put a tick in the relevant column for each observation. It's important to do this even if it's obvious from other details given what the bird is doing as it makes inputting the data easier and can help during the data QA process.

Prey
This column can be used to record any prey that can be identified in feeding birds.

TR
This stands for transect. Put a tick in this box if the observation was 'in transect' and leave it blank if it was not. Observations are in transect if they are on the water and within bands A, B, C or D, or, if they are in flight and are recorded in the snapshot. Time bins where 'no birds' are recorded should be recorded as 'in transect'.

Notes
This column can be used for noting any additional useful info, for example if birds can be identified to subspecies level and behaviour.

Unless you are totally sure of the codes, behaviours such as guarding chick, preening, sleeping and different feeding behaviours should be written (uncoded) in the notes column. This should eliminate the possibility of mistakes being made. Note there are also specific behaviour codes for cetaceans, and 'misfortune' codes, these can be used for birds which are e.g. under attack by kleptoparasitism (common with skuas) or birds which are entangled in fishing gear or rope.

Associations of birds should be bracketed in this column too. A flock of auks may contain two breeding plumage guillemots, three winter plumage guillemots, and a breeding plumage razorbill. This will require three separate lines of data, but by bracketing them in the notes column you can show that they were all associated. Associations should be limited to birds which are clearly forming a single group. Associations are entered into the database by entering the same three-digit code in the 'notes' column for each line of data that is associated. The three-digit codes start at 101 and increase with each 'association event. They reset to 101 at the beginning of each new survey day. It can be wise to fill in the values at the end of the day rather than in the field as mismatches or repetitions are less likely to occur.

Other 'floating matter' should also be recorded in the notes column. This could be anything that might influence the distribution of birds in the area, so any vessels, especially active fishing vessels, should be noted here, as well as organic floating matter such as mats of seaweed or seabird and cetacean carcasses. Record the type and approximate distance for each bit of floating matter observed for every 'bin' that it is visible for (this can easily be done by drawing a line down from the original observation through the notes column, ending at the time the floating matter was no longer visible).

7. Frequently asked questions

How are birds that are observed taking off and/or landing recorded?

All observations should be recorded on the datasheets as they are first observed. There is an exception though: If you are certain that a bird has just taken off from the water, the bird should be recorded as being on the water and given the appropriate distance band.

How do you decide which side of the vessel to count from?

The primary consideration must be the visibility in Band A. If that is not a deciding factor, then consider the presence of glare in other bands and the direction of the wind (looking into the wind can be very difficult). Consider also that it is easier to detect birds when looking down the troughs between waves than it is when looking over the crests. At the end of the day, wherever you can most efficiently detect birds is the ultimate deciding factor.

How do you avoid counting the same bird twice?

Unfortunately, it is impossible to completely rule out double counting. However, ship association is easy to determine in most cases, and eliminating these birds from the data should significantly reduce the chances of double counting birds. Observers should try to remain aware of all birds around the vessel as far as is possible.

What are the best ways to deal with large number of birds?

The most important thing to do is keep calm and keep recording data in as systematic fashion as you can. If you see large numbers of birds ahead, start to record them as early as possible to try and avoid being swamped, although it is necessary to try to get them into the correct time bin as this relates to their location. If necessary, you can reduce effort so that birds in band E are not recorded. You can also use the sides of data sheets to make rough notes on species/number if required before entering the accurate data in the sheets. As you are likely to be observing with a scribe, you can also divide the counting between yourselves (either by species, distance bands, or whether birds are in flight or on the water.

Try to record the essential information (species, number, in/out transect) first, then further information if time allows. Estimated numbers are acceptable, but if time allows try to get better counts.

Why aren't distance bands recorded for birds in flight?

Accurate placement of birds into distance bands is of paramount importance when collecting data suitable for 'Distance' sampling. This process can be standardised using rangefinders for birds on the water, but there are no means available for doing this in flight. Distance sampling also assumes that the distribution of the targets being sampled is random. Generally, the distribution of birds flying around a vessel is not random, with the likelihood of vessel attraction increasing with proximity to the vessel. Recording these birds into distance bands would almost certainly result in a proportional overloading of the closest distance bands. This would lead to populations derived from these numbers being over-estimated.

Appendices

Appendix 1: Trip sheet

Joint Nature Conservation Committee

SEABIRDS AT SEA TRIP DATA

Date .... Base Name .... Sheet .... of ....

TRIP KEY	TIME	BASE ACTIVITY	SCAN ANGLE	TRANS WIDTH	SPECIES COUNTED	DURATION (mins)	OBSERVER(S)	NO. OBS	NOTES

SEABIRDS AT SEA ENVIRONMENTAL SHEET

TIME (GMT)	WIND DIRN	WIND FORCE (B'fort)	SEA STATE	SWELL HEIGHT	VISIBILITY	CLOUD (Oktas)	RAIN	SUN STRENGTH	SUN DIRN	NOTES

Use overleaf for additional notes

Appendix 2: Observation sheet

Joint Nature Conservation Committee
SEABIRDS AT SEA OBSERVATION SHEET

SHIP .... OBSERVER ....

DATE .... PAGE .... OF ....

For office use

Coded:

Checked:

	TIME	SPECIES	AGE	PLU	NUM	DIST	DIRN	FLY	SEA	PREY	TR	NOTES
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
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28												
29												
30												

Appendix 3: Navigation sheet

Joint Nature Conservation Committee
SEABIRDS AT SEA NAVIGATION SHEET

SHIP ....   OBSERVER (s) ....

DATE ....   SHEET .... OF ....

TIME	St/ Mid/	Latitude	N/S	Longitude	E/W	Course	Speed

Appendix 4: Gannet and fulmar plumage coding sheet

JNCC Seabirds at Sea Team

Immature gannet plumage types

Courtesy of Bryan Nelson
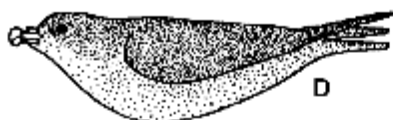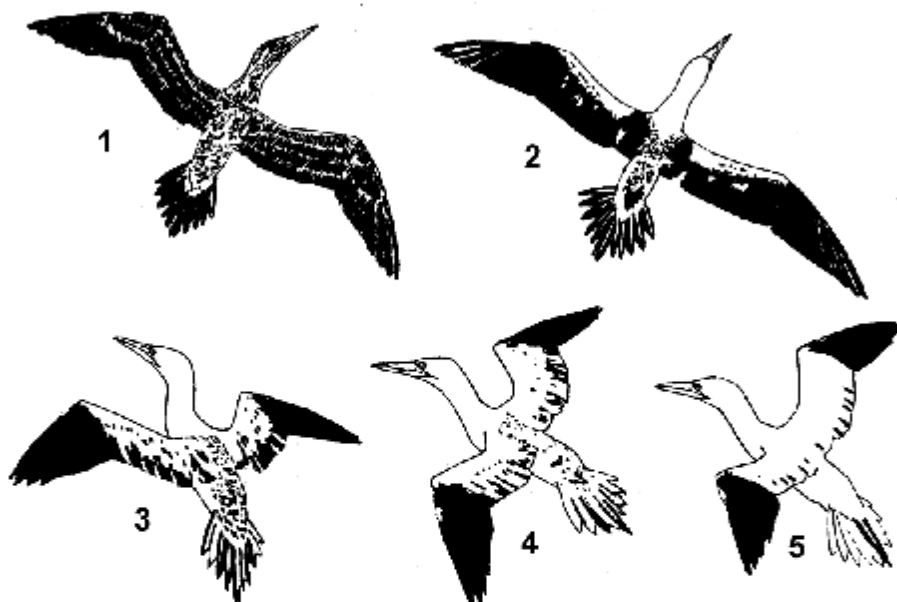
Fulmar plumage phases

Courtesy of Jan van Franeker

Appendix 5: Snapshot timing sheets

Decimal knots	Variable distance in metres									
Knots	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
1	31	34	37	40	43	46	49	53	56	59
2	62	65	68	71	74	77	80	83	86	90
3	93	96	99	102	105	108	111	114	117	120
4	124	127	130	133	136	139	142	145	148	151
5	154	158	161	164	167	170	173	176	179	182
6	185	188	191	195	198	201	204	207	210	213
7	216	219	222	225	229	232	235	238	241	244
8	247	250	253	256	259	263	266	269	272	275
9	278	281	284	287	290	293	296	300	303	306
10	309	312	315	318	321	324	327	330	334	337
11	340	343	346	349	352	355	358	361	364	368
12	371	374	377	380	383	386	389	392	395	398
13	401	405	408	411	414	417	420	423	426	429
14	432	435	439	442	445	448	451	454	457	460
15	463	466	469	473	476	479	482	485	488	491
16	494	497	500	503	506	510	513	516	519	522
17	525	528	531	534	537	540	544	547	550	553
18	556	559	562	565	568	571	574	578	581	584
19	587	590	593	596	599	602	605	608	611	615
20	618	621	624	627	630	633	636	639	642	645
21	649	652	655	658	661	664	667	670	673	676
22	679	683	686	689	692	695	698	701	704	707
23	710	713	716	720	723	726	729	732	735	738
24	741	744	747	750	754	757	760	763	766	769
25	772	775	778	781	784	788	791	794	797	800

Constants

Knots to KPH   1.853

Changeables

Time period   1 (minutes)

Example:

Use this table if looking ahead at a fixed time (1 minute) ahead of the ship for your snapshot counts.

If your ship is travelling at 9.7 knots, read down the left-hand column to the row labelled '9' then across this row until in the column headed '0.7'. The value in this cell, '300', means that you should look ahead 300 metres for each snapshot count.

Decimal knots Knots	Variable time in seconds 0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
1	583	530	486	448	416	389	364	343	324	307
2	291	278	265	253	243	233	224	216	208	201
3	194	188	182	177	171	167	162	158	153	149
4	146	142	139	136	132	130	127	124	121	119
5	117	114	112	110	108	106	104	102	100	99
6	97	96	94	93	91	90	88	87	86	84
7	83	82	81	80	79	78	77	76	75	74
8	73	72	71	70	69	69	68	67	66	65
9	65	64	63	63	62	61	61	60	59	59
10	58	58	57	57	56	56	55	54	54	53
11	53	53	52	52	51	51	50	50	49	49
12	49	48	48	47	47	47	46	46	46	45
13	45	44	44	44	43	43	43	43	42	42
14	42	41	41	41	40	40	40	40	39	39
15	39	39	38	38	38	38	37	37	37	37
16	36	36	36	36	36	35	35	35	35	34
17	34	34	34	34	33	33	33	33	33	33
18	32	32	32	32	32	32	31	31	31	31
19	31	31	30	30	30	30	30	30	29	29
20	29	29	29	29	29	28	28	28	28	28
21	28	28	27	27	27	27	27	27	27	27
22	26	26	26	26	26	26	26	26	26	25
23	25	25	25	25	25	25	25	25	24	24
24	24	24	24	24	24	24	24	24	24	23
25	23	23	23	23	23	23	23	23	23	23

Constants
Knots to KPH   1.853

Changeables
Distance   300 (metres)

Example:
Use this table if looking ahead a fixed distance (300 metres) ahead of the ship for your snapshot counts.
If your ship is travelling at 9.7 knots, read down the left-hand column to the row labelled '9' then across this row until in the column headed '0.7'. The value in this cell, '60' means that you should do snapshot counts every 60 seconds.

Appendix 6: Wind speeds and sea states

The detail in the table below is taken from Wikipedia – see
http://en.wikipedia.org/wiki/Beaufort_scale

Beaufort Wind Force	Wind speed	Sea height	Sea description
0	< 1km/h	0	Sea like a mirror.
1	1.1 - 5.5km/h	0.1m	Appearance of scales, but without foam crests.
2	5.6 - 11km/h	0.2 - 0.3m	Crests have glassy appearance and do not break
3	12 - 19km/h	0.4 - 1m	Crests begin to break. Any foam has glassy appearance, scattered whitecaps.
4	20 - 28km/h	1 - 2m	Small waves becoming longer, fairly frequent white horses.
5	29 - 38km/h	2 - 2.5m	Moderate waves taking more pronounced long form. Many white horses, chance of some spray.
6	39 - 49km/h	2.5 - 4m	Larger waves begin to form. Spray is present. White foam crests are everywhere.
7	50 - 61km/h	4 - 5.5m	Sea heaps up. White foam from breaking waves blown in streaks with the wind.
8	62 - 74km/h	5.5 - 7.5m	Moderately high waves of greater length. Edges of crests begin to break into spindrift. Well-marked foam streaks.
9	75 - 88km/h	7.5 - 10m	High waves, Dense streaks of foam, wave crests begin to topple, spray may affect visibility.
10	89 - 102km/h	10 - 12.5m	Very high waves with long overhanging crests. Large patches of foam blown in dense white streaks. Sea surface takes white appearance, tumbling of sea is heavy and shock like.
11	103 - 117km/h	12.5 - 16m	Exceptionally high waves, small to medium sized ships being lost to view behind waves. Sea covered with long white patches of foam. Edges of wave crests blown to froth.
12	118km/h +	16m +	Sea completely white with driving spray, Visibility seriously affected as the air is filled with foam and spray.

Appendix 7: Behaviour guide

BEHAVIOUR CODES LISTS DATABASE

30 Holding prey	32 Feeding young	34 Wading	35 Scooping prey
36 Aerial pursuit	37 Skimming	38 Hydroplaning	39 Pattering
40 Scavenging	41 Scavenging at trawler	42 Dipping	43 Surface seizing
44 Surface pecking	45 Deep plunging	46 Shallow plunging	47 Pursuit plunging
48 Pursuit diving	[56] 48 Social pursuit divers	49 Actively searching	49 Actively searching
60 Resting or asleep	61 Courtship display	62 Courtship feeding	63 Copulating
64 Carrying nest material	65 Guarding chick	66 Preening, bathing	

33 'feeding'
90 Chased by kleptoparasite
91 Under attack by bird
92 Under attack by mammal
96 Entangled
97 Oiled
98 Sick, unwell
99 Dead

Appendix 8: How to use the MESA2 Tablet and app for VSAS surveys

You will need to complete all these steps if using the seabirds at sea survey app.

1. Turn the tablet on by holding down the **power button** at bottom right hand side for a two to three seconds.

2. When the tablet is on, **swipe up with finger** on screen and, when the password box appears, tap your finger on it and enter the **password** provided to you the using keyboard.
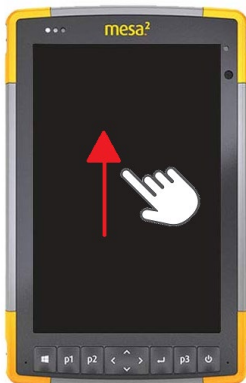
3. Double tap the **Roam icon** at the bottom left of the screen and wait for the program to load. This can take 5 to 10 seconds.

4. Tap the **ESAS blue map** icon on the top left of the screen.

Note: the tablet should now be held in landscape after this step (i.e. horizontally).
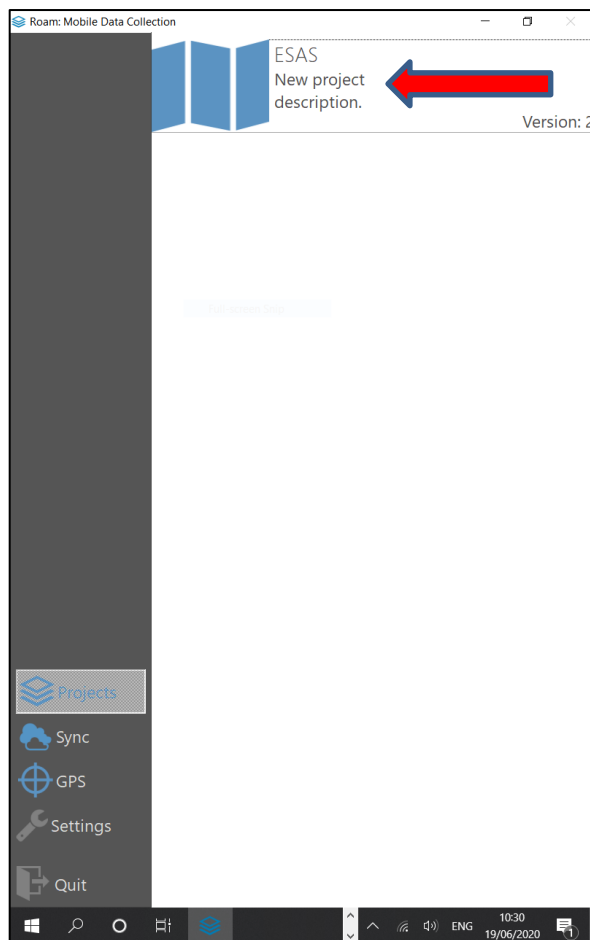
5. Tap the **target icon** (top right-hand corner of screen) which should change from blue to grey. While grey, it is searching for satellites.
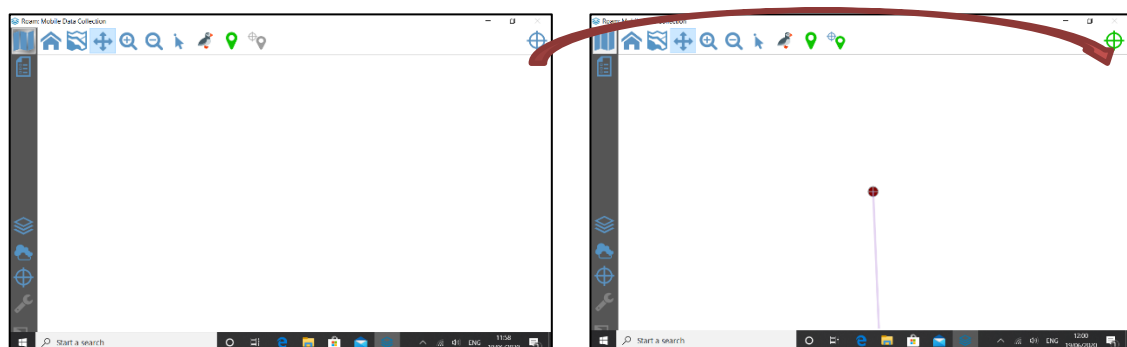
6. The tablet may take several minutes to locate satellites to enable the app. to receive position data. The target will turn **green** when the app is ready to use. It is advisable to go outside or close to a window, to ensure the tablet can receive satellite data.

7.   Tap the **target icon** on the **bottom left-hand side**.
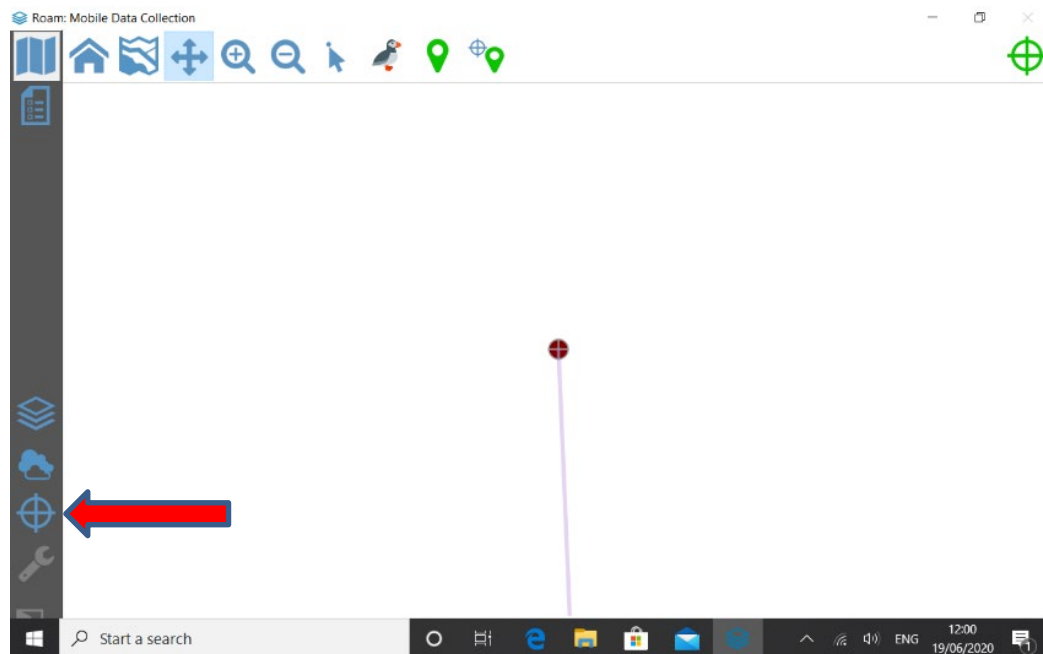
Check that **GPS Active** and **GPS Logging Active** are both written in **green**.
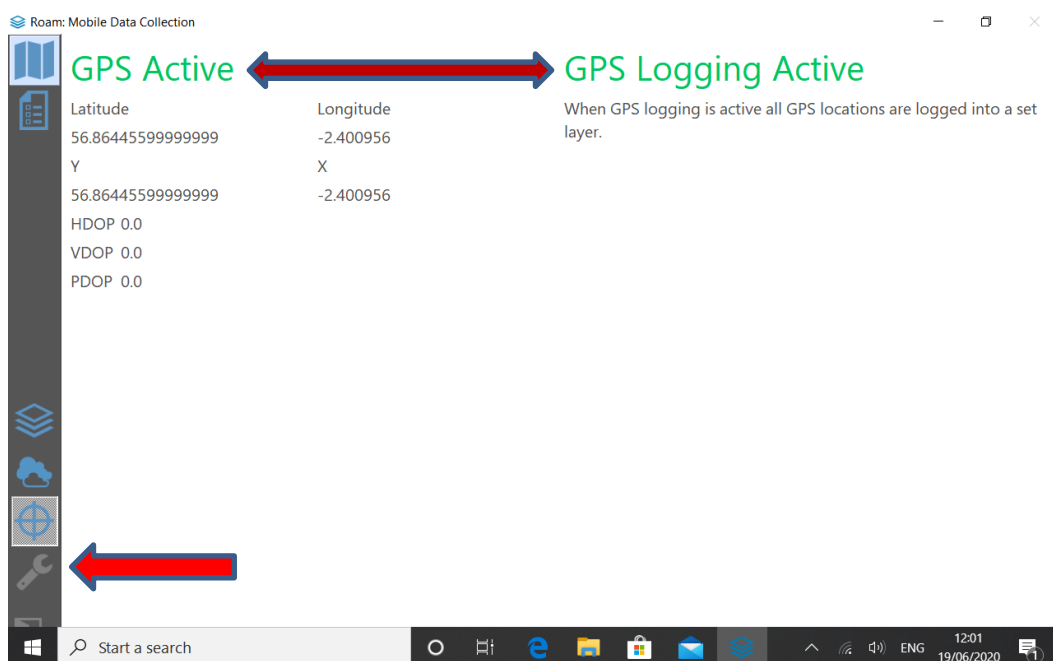
If orange, tap the **spanner icon** on the bottom left-hand side and then tap the **target icon** above it again. They should now both be written in green.

8.   Tap the **blue map icon** at the top left of the toolbar. You should now see a position icon on the screen, with a track being created behind it.
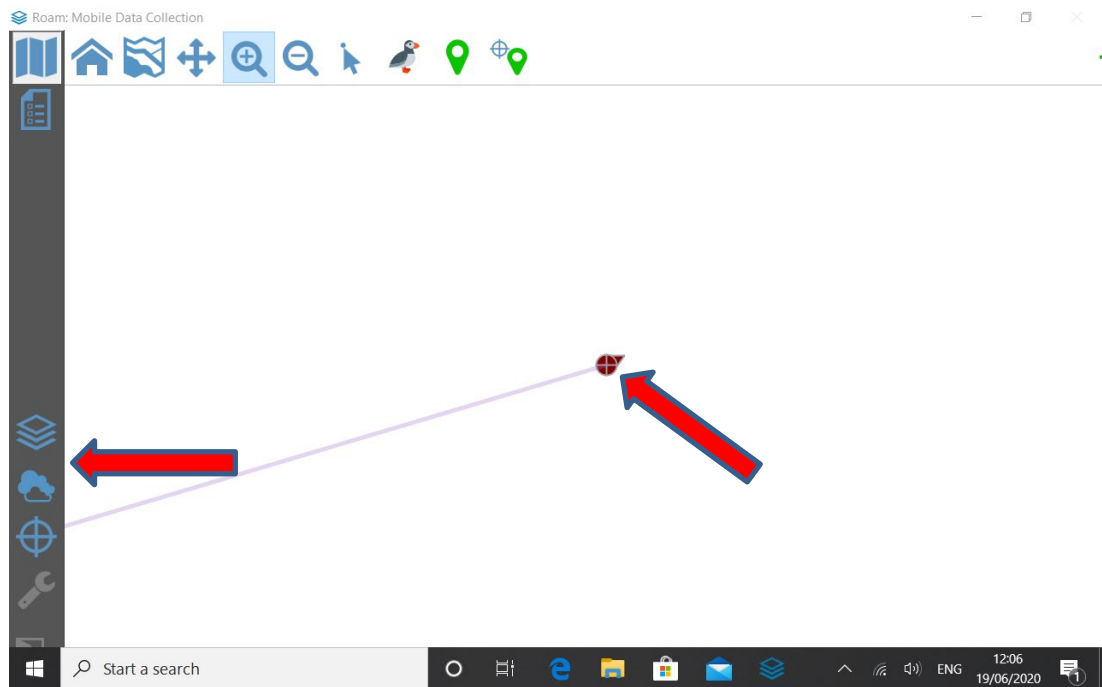
9.   In the toolbar at the top of the screen, tap the **puffin icon**.
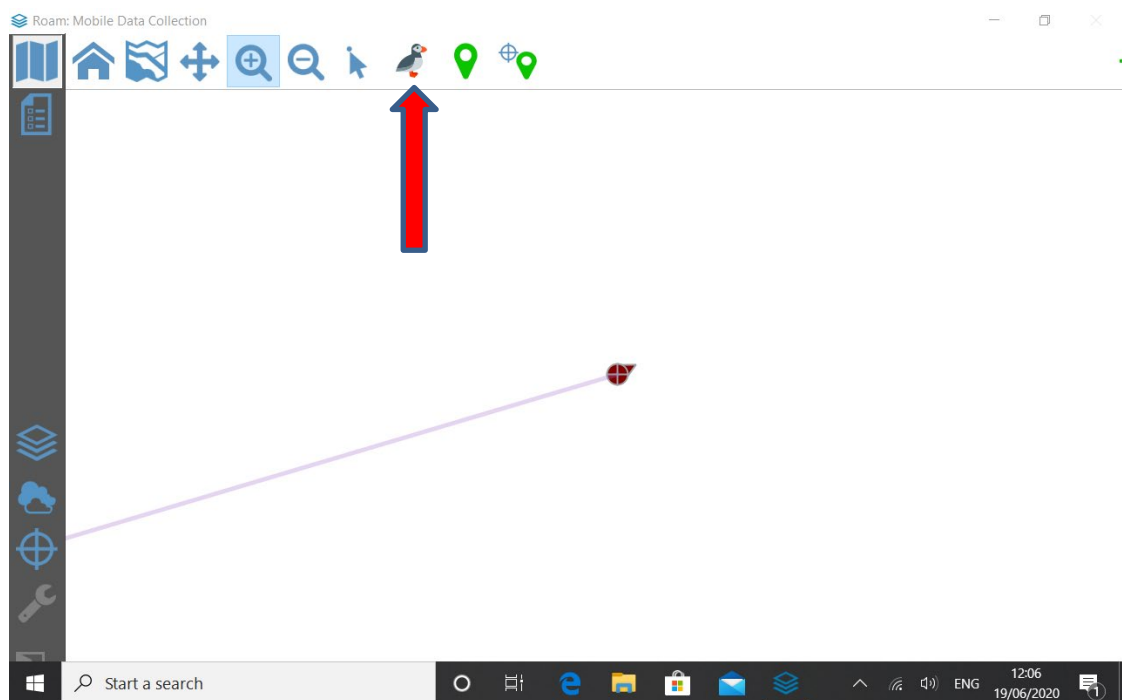
10. Tap the **'Trip details'** **boat icon**.
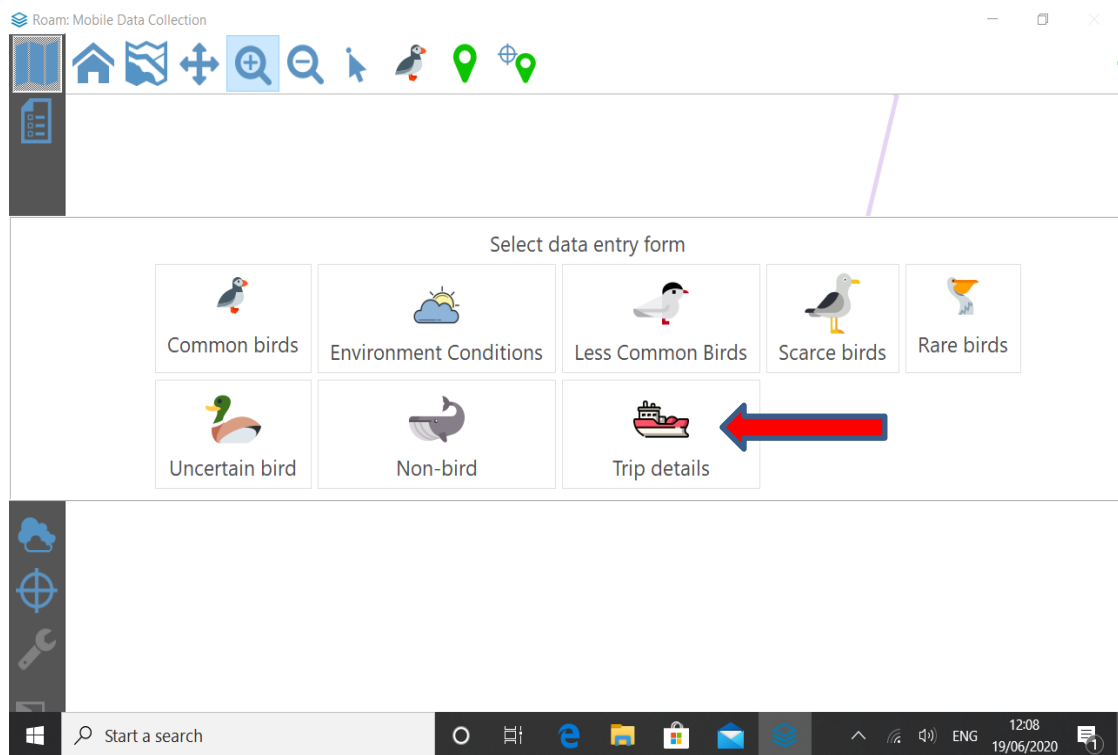
11. Tap the **digitise icon** to open the trip details window.
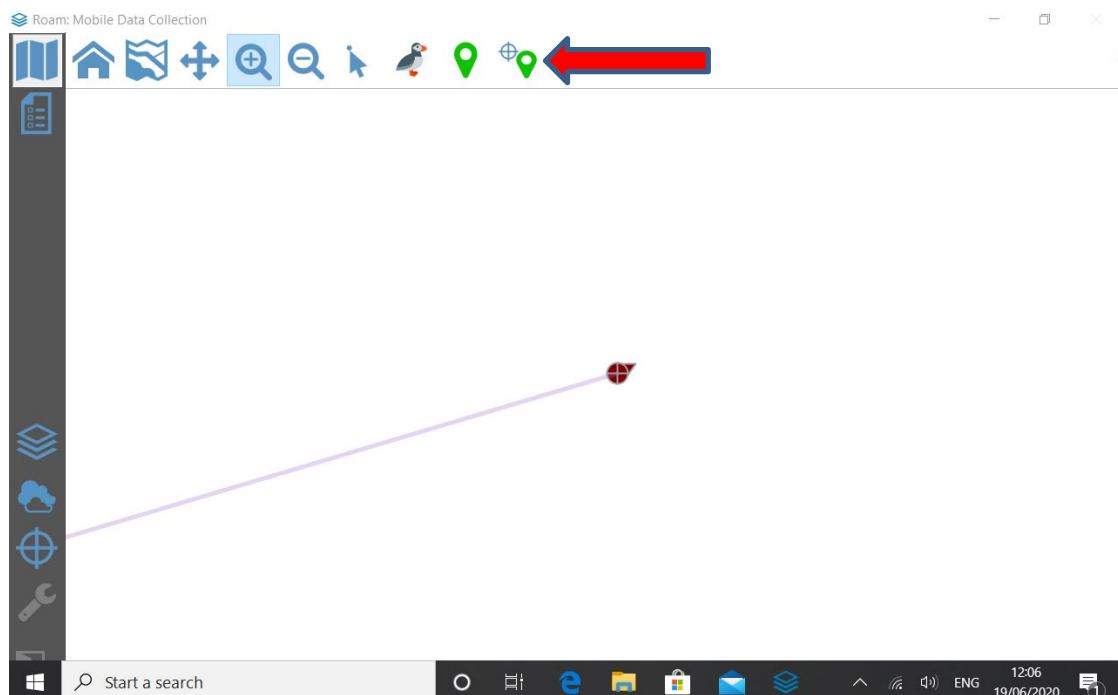
12. Enter the trip details using the buttons and text boxes by selecting the value for each category with a tap of the relevant button, using free text, or the **–** and **+** buttons. Buttons will turn blue when selected and you can change the value by tapping another button if you make a mistake.

13. On a standard ESAS method survey you would select:

- **Base Activity**: Steaming
- **Scan angle**: 90^0
- **Species Co:** All species recorded
- **Date and time**: Recorded automatically, so don't change

And using free text or **–** and **+** buttons

- **Transect width**: 300
- **Duration**: Leave blank
- **Observers**: Initials of observer(s) doing survey
- **Observer number**: The number on your ESAS cert, if you have one
- **Notes**: Use this box to highlight anything that cannot be captured by the other fields.

NOTE: to input text, tap the field you wish to type in and the keypad will appear at the bottom of the screen. Before typing, use the scroll bar on the right-hand side to move the field you are typing into to the top of the screen. This allows you to see what you are typing.

You can also move the screen up or down by holding your finger against the screen and moving it but be careful not to change any entries while doing this. The safest option is to use the scroll bar on the right-hand side.

14. When complete, tap **save.**

15. Tap the **boat icon** at the top of the screen and then the environment conditions **cloud and sun icon.** Then tap the **digitise icon** to open the environment conditions window.

16. Enter the environmental conditions by selecting a value from each category with a tap of the relevant button. The button will turn blue when selected and you can change the value by clicking another button if you make a mistake.

NOTE: you must enter a new record whenever there is a recordable change in any environmental conditions, including whether you have a true or false horizon. When entering subsequent environmental conditions records, it is likely that this will be after you have recorded observation data and that the icon you will need to tap at the top of the screen will now be a puffin.

When done, tap **save**.

17. In the toolbar at the top of the screen, tap the **cloud and sun icon**.

    Tap the common birds' **puffin icon,** then the **digitise icon** to open the common birds window.

18. When you are ready to start the survey, tap the **Start** button at the top left of the common birds' window, and then **save**.

NOTE: you do not need to hit start/stop when you change trip or environmental details, just at the beginning and end of each survey.

19. You are now ready to start recording observations data.

    To record a common bird observation, tap the **digitise icon** and complete all **(required)** fields as follows.

NOTE: You will need to repeat this for each subsequent observation.

- **Species**: tap relevant box (do not select start or stop)
- **Number**: tap relevant box (1 to 9), free text box (>9) or **–** and **+** buttons.
- **Distance**: tap relevant box (A to E for birds on water and F for flying)
- **Transect**: tap if 'In' or 'Out' of transect ('In' if flying bird is in snapshot)

20. To record supplementary data (**Direction**, **Plumage**, *etc*.), **scroll** to the bottom of the page. This may seem inconvenient, but the app was designed to ensure essential fields were at the top to minimise scrolling during busy periods.

   If you observe marine litter, tap the **Litter** button at the bottom of the screen.

   To record an association between two different observations, tap the **Association** button. This will associate the current record with the next one you add.

   When all data have been entered tap **Save**.

NOTE: If you need to record less-common birds, scarce birds, rare birds, or non-bird observations (e.g. cetaceans, sharks, *etc*.) you need to switch to the appropriate menu. Tap the **puffin icon**, select the appropriate data entry form, then tap the **digitise icon**. You will also need to repeat this step when switching back to common bird observations, environment conditions records, *etc*.

21. Once saved, records can be edited by tapping the **arrow with point icon** at top of screen then the relevant **data point** on the map. You can then edit the details that appear in the panel on the right-hand side. To edit a record, tap on the **pencil with keyboard icon** and **save** when you have finished editing. To close the editing panel, tap **X**.
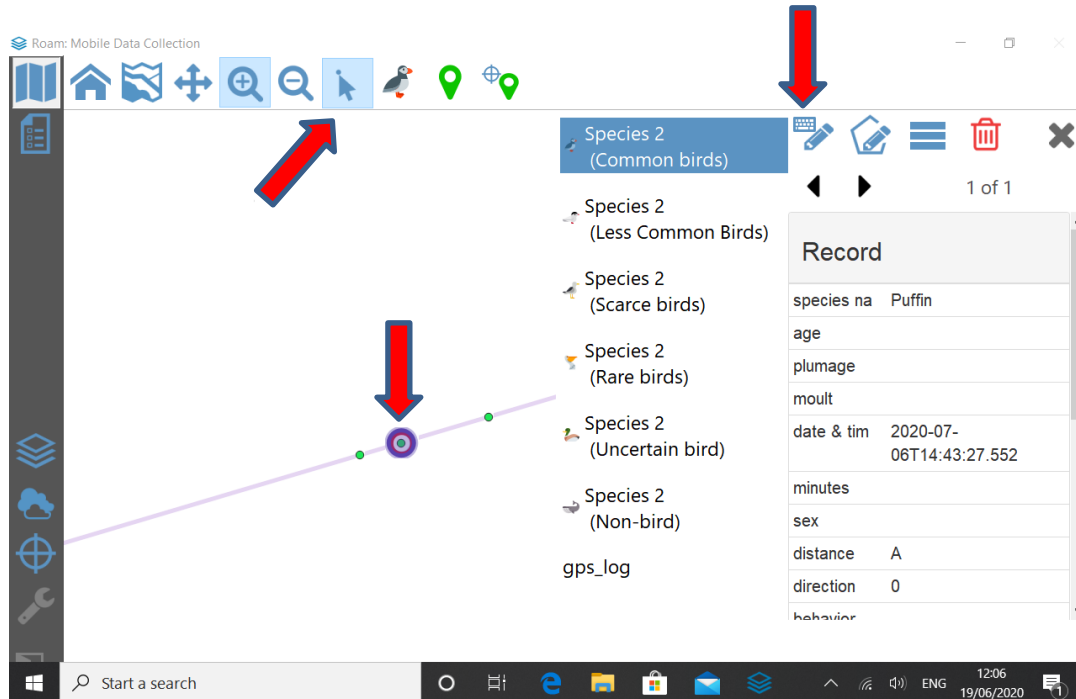
22. When you finish a survey, go to the common birds' menu, tap the **digitise icon** and then tap the **Stop button**, **Save**, then **close the app**.

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Table 1: Species categories for app.

Common birds	Less common birds	Scarce birds	Rare birds	Uncertain birds
Start	Sand tern	GC grebe	Surf scoter	Black backed gull
Stop	LBBG	RN grebe	King eider	comm gull/kitti
Gannet	Manx Sh	BN grebe	Feas type	Auk sp
Fulmar	Sooty Sh	Pom skua	Ross's gull	gull sp
Kitti	Great Sk	LT skua	Ring-billed gull	Skua sp
Com gull	Arctic Sk	Goosand	Laughing gull	small skua sp
GBBG	Goldeneye	LT duck	Franklins gull	diver sp
Herr gull	Comm Sco	Velv sco	Wilson's petrel	tern sp
Guilli	BT diver	Little tern	Ivory gull	duck sp
Razor	Cormorant	Black tern	Brunnichs Guill	petrel sp
Puffin	Eider	Grey phal	White-winged tern	commic tern
Tystie	Storm petrel	RN phal	Barolo shear	shearwater sp
GN diver	Comm tern	Leach's p	Gull-billed tern	small gull sp
RT diver	Slav grebe	WB diver	Caspian tern	Corm/shag
Shag	Glauc gull	Bal shear	Am Herring gull	
BH gull	Ice gull	Cory's sh	Stellers eider	
RB merg	Scaup	Great sh	Forsters tern	
Arc tern	Little auk	Roseate tern	BB albatross	
GU/RA	Med gull	Casp gull		
Large gull sp	Little gull	YL gull		