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Eastern Canada Seabirds at Sea (ECSAS) standardized protocol for pelagic seabird surveys from moving and stationary platforms

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Atlantic Region

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EASTERN CANADA SEABIRDS AT SEA (ECSAS) STANDARDIZED PROTOCOL FOR PELAGIC SEABIRD SURVEYS FROM MOVING AND STATIONARY PLATFORMS

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ABSTRACT

Marine birds play an important role in marine ecosystems and their responses to oceanographic variability can be used to monitor changes in the marine environment. To understand their roles and to identify and minimize human impacts on birds at sea, data on their offshore distributions and abundance are required. Numerous methods are employed throughout the world's oceans to study seabirds at sea from ships, but for studies to be comparable, methods have to be standardized. In Atlantic Canada, data were collected between 1966 and 1992 under PIROP (Programme Intégré de Recherches sur les Oiseaux Pélagiques), but there was no systematic monitoring of birds at sea after the mid-1980s. In 2005, the Canadian Wildlife Service of Environment Canada re-initiated the pelagic seabird monitoring program in eastern Canada (Eastern Canada Seabirds at Sea; ECSAS) and developed a survey protocol based on those used elsewhere in the Atlantic. We record birds observed along a line transect, scanning a 90^o arc to one side of the ship, and follow the recommended snapshot approach for flying birds (Tasker et al. 1984). Distance sampling methods are incorporated to address the variation in bird detectability. This method allows the estimation of seabird densities. In this report we describe the general methods we use to conduct seabird surveys at sea, and then provide detailed instructions on how to fill out each data field. We also provide worked examples for surveys from moving and stationary platforms. It is our hope that this report will serve as a guide for other such studies in the Atlantic and beyond so that comparisons of seabird communities can be made among regions and between research organizations.

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1. INTRODUCTION

1.1 History of pelagic seabird surveys in eastern Canada

Gathering systematic information on the pelagic distribution of seabirds in eastern Canadian waters was pioneered by R.G.B. Brown (Canadian Wildlife Service; CWS) through PIROP (Programme Intégré de Recherches sur les Oiseaux Pélagiques), a joint initiative between the Canadian Wildlife Service and P. Germaine at l'Université de Moncton. Data collection under PIROP occurred from the late 1960s until the early 1990s, with the bulk of the data collected during the 1970s. In addition to doing much of the field work, R.G.B. Brown published extensively on the oceanographic factors that influence seabird distribution (e.g., Brown 1970, 1976, 1979, 1985), and produced a series of atlases summarizing the seasonal distribution and abundance of seabirds in the northwest Atlantic (Brown et al. 1975, Brown 1977, 1986). In the early 1990s, A.R. Lock (CWS) organized the PIROP data into one database and published a Gazetteer, which re-mapped the pelagic distribution of seabirds throughout the northwest Atlantic, with special emphasis on abundance and distribution of seabirds vulnerable to marine oil pollution (Lock et al. 1994). The PIROP database has since been used to examine seabird migration, seasonal moult, and the abiotic factors that influence seabird distribution (Huettmann 2000, Huettmann and Diamond 2000, 2001a,b, 2006).

The PIROP database continued to be relied on heavily well after data collection had ceased, particularly as it related to environmental assessments and impact statements associated with increasing offshore oil and gas activities and the high chronic oiling rates of seabirds reported along the east coast (Wiese and Ryan 2003, Lucas and MacGregor 2006). By the early 2000s, it became evident that current data were required to fill substantial spatial and temporal gaps in the database, and that a revival of a pelagic seabird survey program was necessary. An important step toward this implementation was to develop a standardized survey protocol.

1.2 Development of the standardized protocol

Early PIROP surveys were based on 10 min observation periods during which all birds observed were recorded, regardless of their distance from the moving vessel. These surveys were designed to gather information on the relative abundance and distribution of seabirds, and the short recording periods allowed observations to be related to the variable oceanographic conditions of the area (Brown et al. 1975). Following a review of survey methods by Tasker et al. (1984), PIROP surveys after 1984 recorded birds observed within a 300 m band transect, scanning a 90^o arc to one side of the ship. This change in protocol allowed the estimation of densities (i.e., birds per square kilometer) but the protocol did not adopt the recommended snapshot approach for flying birds, which often move faster than the ship and thus inflate estimates of local density (Tasker et al. 1984, Gaston et al. 1987). During the re-vitalization of the pelagic seabird survey program for the Canadian east coast in the early 2000s, A.R. Lock recommended that CWS seek pan-Atlantic coordination and develop survey protocols based on those used by the European Seabirds At Sea (ESAS) group. This was successfully established with the help of K. Camphuysen, past chair of the ESAS group, who generously provided materials and at-sea training on current seabird survey practices in the North Sea.

Standardised data collection among institutes of various countries bordering the North Sea began in the early 1980s, with the establishment of the ESAS database. Early surveys focused on assessing the vulnerability of certain areas to surface pollutants and were therefore designed to collect data that allowed the mapping of relative abundance and distribution of seabirds at sea (see Camphuysen 1996 for review). More recently, surveys in the North Sea have evolved to include the collection of detailed behavioural data, with considerable interest in foraging behaviour of individuals (Camphuysen and Garthe 2004). The methods require extensive training and practice for an observer to gain proficiency in identifying and recording the 92 codes for behaviour and association, in addition to the flight direction data, and were deemed too detailed for the proposed pelagic seabird survey program in eastern Canada. Therefore, a selection of behavioural and association codes taken from the ESAS protocol have been implemented along with the general methods used by European observers, to develop the standardized protocol presented in this report. This protocol will allow for direct comparison with data collected currently in the northeast Atlantic.

We developed a standardized protocol for surveys conducted from two types of observation platform, moving (e.g., oceanographic research or platform supply vessels) and stationary (e.g., oil production rig or supply vessel on stand-by). The protocol for surveys conducted aboard moving platforms was modelled after Tasker et al. (1984), and the protocol for stationary platforms was adapted from methods described in Tasker et al. (1986) and Baillie et al. (2005). Distance sampling methods were included to address variation in bird detectability and to allow for calculation of correction factors to account for missed birds (Buckland et al. 2001). We also reduced the observation period length from 10 min to 5 min in order to obtain more precise spatial information for each bird sighting. This change does not, however, affect our ability to compare seabird densities to those surveys that use longer observation periods. The Eastern Canada Seabirds at Sea (ECSAS) program has used this survey protocol, with minor modifications, in eastern Canada since 2006 (Gjerdrum et al. 2008, Fifield et al. 2009), during which time almost 80,000 km of transect have been surveyed and 144,000 birds counted. In this report, we describe the general methods we use to conduct surveys, and then describe each data field in detail. A series of appendices provide distance estimation equations, data field coding details, example surveys and blank datasheets.

2. GENERAL REQUIREMENTS FOR SEABIRD OBSERVERS

Seabird observers collecting data on pelagic seabird occurrence and behaviour for the ECSAS program are required to use this standardized protocol. It is also strongly recommended (and may be required) that each observer participate in a training workshop. The workshop includes instruction on boat safety, survey methods, distance sampling, and seabird identification. Instruction takes place in a classroom, although students will also be expected to train with an experienced observer at sea. Students will be evaluated in their understanding of the recording methods and seabird identification. As trips can last anywhere between three days and six weeks and travel in a variety of environmental conditions, observers can expect to stand for long periods of time, often under arduous conditions. Limited space on board the vessels may also require observers to share living areas. To ensure the highest quality of data is collected, observers should have the following:

- Experience working with seabirds and a strong knowledge of their behaviour and ecology
- Ability to rapidly identify Atlantic seabirds in all plumages, in various lighting conditions, reduced visibilities, and in rough ocean conditions

- Ability to follow the ECSAS protocol for surveying seabirds at sea
- Ability to accurately record data on data sheets (or electronically) according to protocol, including information on vessel, weather conditions, and birds
- Ability to work independently
- Experience travelling in boats and an ability to work in rough sea conditions without getting seasick
- Good communication skills and the ability to live and work closely with ship's crew and staff for extended periods of time

3. DISTANCE SAMPLING: THE IMPORTANCE OF RECORDING DISTANCES TO BIRDS

3.1 Introduction to Distance Sampling

A crucial question to address in any survey program is that of detection probability. It is well known that some birds will be missed by even the best observer due to sea and weather conditions, vessel characteristics, observer fatigue, etc. (Buckland et al. 2001). The question is, how many? If we do not account for detectability we are forced to assume that all animals within the survey transect are detected, which will underestimate abundance, perhaps drastically. In that case, all we can produce are (likely biased) indices of relative abundance. Relative abundance indices are difficult to compare between surveys, years, observers, etc. when variation in detectability is not assessed (i.e., failure of the assumption of constant proportionality) (Norvell et al. 2003).

Distance sampling is a powerful technique that allows us to estimate the proportion of birds present that are actually detected (i.e., detection probability) and to automatically factor this into abundance calculations (Buckland et al. 2001). Distance sampling is based on the premise that the likelihood of detecting a bird decreases the further away it is from the observer. Likewise, detectability varies by species and environmental conditions.

The subsequent data analysis involves the use of specialized software called Distance (Thomas et al. 2010). The software works by comparing the number of birds actually observed within each distance class (Figure 1) with the number that would have been counted if every bird had been detected. If all birds present were detected, then on average there should be equal numbers of birds in each equal-size distance class[†]. This is the same as saying that birds in all distance classes have equal detection probability (Figure 2a). In reality, this never happens. Bird detectability and thus the number in each distance class decreases with distance from the observer. This can readily be seen by simply plotting the number of birds actually observed in each distance class as a histogram. The histogram in Figure 2b shows a typical data set where detection probability decreases with distance. The smooth dark line is a curve that has been fit to the histogram. A correction factor, called the detection probability, is computed by dividing the area under the curve by the area of the entire dashed rectangle. The distance sampling software does this and thus computes abundance, taking birds that were missed into account. Note that detectability will also be affected by other factors including the identity and behaviour of the species, weather conditions, sea state, and observer, all of which the software factors into the analysis (Thomas et al. 2010).

[†] Distance automatically adjusts for distance classes of unequal width.

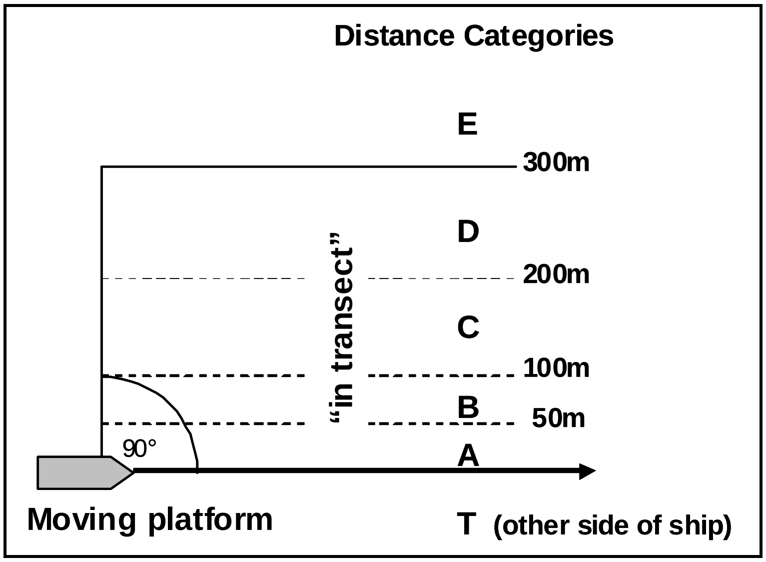

Figure 1. Illustration of a survey using a 90° scan, covering a 300 m transect from a moving platform. All birds observed within this transect, whether flying or on the water, are recorded. The perpendicular distance from the line to birds detected on the water or in flight is estimated. Birds observed outside the transect are normally also recorded if this does not affect observations within the transect. Distance categories "E" and "T" are both considered not in transect.

For distance sampling to work, all the observer has to do is estimate the distance to each flock of birds, which we do in distance classes or "bins" (Figure 1). Note that the mathematical framework requires that the observer records the *perpendicular* distance from the ship's track line to each flock (Figure 1). Imagine extending a 300 m long "yardstick" perpendicular to the ship, counting each flock and estimating its distance as it passes under the stick. In this way, a 300 m wide rectangular swath of ocean is surveyed as the ship proceeds. In reality, it is often necessary to estimate the perpendicular distance before the ship reaches a flock of birds because they are in flight or to ensure that birds on the water are not displaced by the ship (see section 4.1).

3.2 Analysis assumptions

Distance sampling produces unbiased density estimates while depending on only a small set of assumptions (Thomas et al. 2010). These include: 1) all birds on the line (i.e., within the first distance class) are detected, 2) birds are neither attracted to nor displaced by the survey platform before being detected (requires looking well ahead of the vessel for some species) and 3) distances are measured accurately. The first assumption is due to the internal mathematics used by the software to compare the relative numbers of birds in each distance class. If many birds in distance class "A" are missed, then the computed probability of detection will be artificially high, resulting in an underestimate of abundance. It is therefore extremely important to ensure that all birds in the first bin are detected. However, a balance of effort is required so that observers are not concentrating so much on birds that are close to the vessel that they will miss other more distant birds. In order to avoid violating the third assumption, observers are also required to look well ahead of a moving platform to detect birds before they dive or fly away.

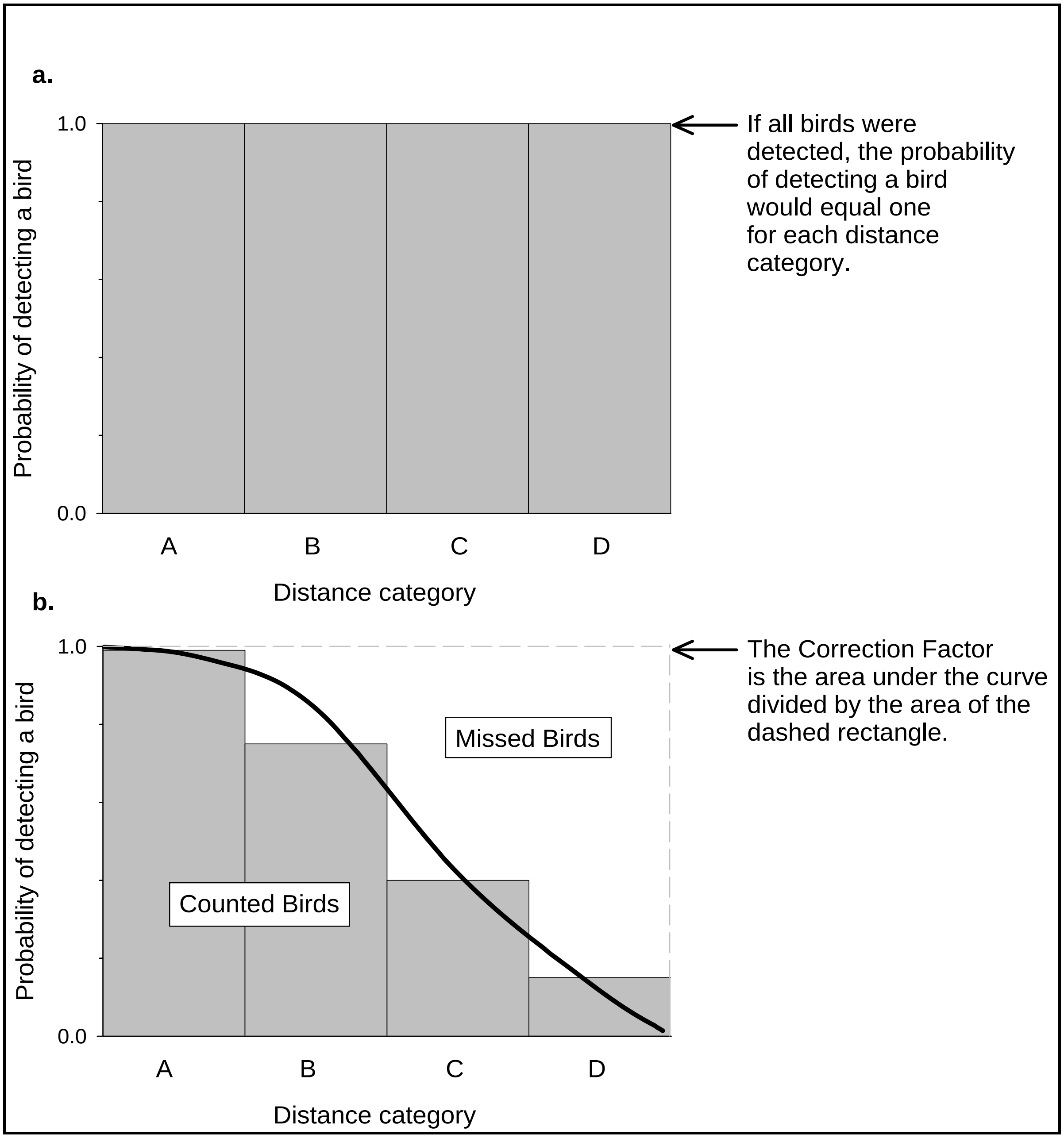

Figure 2. Typical example showing how the histogram would look if (a) all birds were detected, and (b) detectability of birds decreasing with increasing distance. The correction factor is computed as the area under the curve divided by the area of the entire dashed rectangle.

4. GENERAL METHODS FOR SEABIRD SURVEYS

4.1 Surveys from moving platforms

Surveys are conducted while looking forward from the moving survey platform, scanning at a 90^o angle from either the port or starboard side (Figure 1). The transect is continuously surveyed by eye to count and identify birds present in air or on water. Binoculars are used to confirm species identification, and other details, such as age, moult, and behaviour. Observers scan ahead regularly (e.g., every minute) to detect birds that may dive as the ship approaches. If large concentrations of birds in the transect fly off as the ship approaches, binoculars can be used to help count individuals, and these birds are recorded as being on water. Priority is given to birds observed in transect (Figure 1). Birds not in transect are also important and are recorded if these observations do not interfere with observations of birds in transect.

A survey consists of a series of 5 min observation periods, which are exclusively dedicated to detecting birds. As many consecutive 5 min observation periods are conducted as possible, regardless if birds are present or not, and consistent coverage throughout the day is encouraged. The transition between observation periods may take one or two minutes, in order to record the vessel’s position and any conditions that may have changed since the last 5 min observation period (see Section 5.1 on recording observation period information). Transits longer than two hours may need to be broken up to avoid observer fatigue.

Surveys are best conducted when the platform is travelling at a minimum speed of 4 knots (7.4 km/h) and a maximum of 19 knots (35.2 km/h). Surveys can be done when the ship is travelling less than 4 knots, but birds are often attracted to slow moving or stationary vessels. If birds are clearly gathering around the vessel and settling on the water when the ship is moving at decreased speeds (i.e., less than 2 knots), cease your observations. If the ship is no longer moving at all, switch to the protocol used for stationary surveys (section 4.2). When visibility is poor due to rain or fog and the entire width of the 300 m transect is not visible, surveys from moving platforms can still be conducted, however, observers must record the width of the transect that is visible during the survey (e.g., 200 m) in the “Notes” section of the record sheet (see Appendix X for blank record sheets). When no birds are detected during a 5 min period, it is important to record “No birds observed” on the datasheet. If vessel speed or direction changes significantly during an observation period, record the time and location of termination and begin a new observation period.

Observers should practice estimating the locations of the various distance bands. This is best accomplished with a distance gauge made from a transparent plastic ruler (see Appendix I). This gauge should be kept close at hand to quickly verify bird distances.

4.1.1. Detecting and recording bird sightings

One of the primary goals of pelagic surveys is to quantify bird distribution and abundance. To do this, we need estimates of density, which is the number of birds occupying a prescribed area of ocean surface at any given instant in time. During a 5 min observation period, a 300 m wide rectangular area of ocean will be covered (see Figure 1, Appendix VII), the length of which is determined by ship speed. For example, for a ship traveling at 10 knots, the rectangle will be 300 m wide and approximately 1500 m long. To compute bird density, it would be ideal to be able to count all birds that occur within this rectangle *at a single instant in time,* before they swim or fly away, giving a measure of birds/km^2. Since we do not have the ability to see the entire area simultaneously, birds must be counted as the ship approaches them.

4.1.2. Recording birds on the water

All birds observed on the sea surface are continuously recorded throughout the 5 min period and their perpendicular distance from the observer is estimated (Figure 1). If a bird appears to have been flushed off the water, it is counted as a bird on water and not subsequently counted as a flying bird during a snapshot – see below. Observers scan ahead regularly (e.g., every minute) to detect birds that may dive as the ship approaches.

4.1.3. Recording birds in flight

During the observation period, more birds will fly through the survey area than were present in that area at a single instant in time (Tasker et al. 1984). The faster the birds fly relative to the ship's speed, the greater the number of birds will pass through the transect area during a 5 min period. If these flying birds are counted continuously as they are encountered, their density will be overestimated by an amount that is proportional to the relative speeds of the bird and observer (Tasker et al. 1984, Spear et al. 1992). Therefore, flying birds are recorded using a series of instantaneous counts, or snapshots, at regular intervals along the transect (see Appendix VII for an example). The time interval between snapshots depends on the speed of the ship and is chosen so that the ship moves roughly 300 m between snapshots (Table 1). For example, if the platform is moving at a speed of 10 knots, snapshots will occur every minute for the duration of the 5 min observation period. At the time of the snapshot, all flying birds within the transect and up to 300 m ahead of the observer are counted (Figure 1, Appendix VII). In this way, the entire survey transect is covered by a series of instantaneous snapshots. During each snapshot, flying birds are recorded as in transect only if they are within 300 m to the side and 300 m ahead of the vessel (Figure 1). All other flying birds that are seen beyond 300 m OR between snapshot intervals are recorded as not in transect. Birds recorded not in transect (or not in semi-circle for stationary surveys) provide important information on distribution, timing of occurrence, and behaviour, and effort should be made to record them if at all possible. Nothing is recorded if no birds are observed during the snapshot. *It is important to remember that all 5 min observation periods begin with a snapshot of flying birds.*

Table 1. Intervals at which instantaneous snapshot counts of flying birds are conducted from a moving platform.

Platform Speed (knots)	Interval between counts (min)
< 4.5	2.5
4.5 - 5.5	2
5.5 - 8.5	1.5
8.5 - 12.5	1
12.5 - 19	0.5

4.1.4. Lines of flying birds

Some species (e.g., murres (*Uria* spp.), Northern Gannets (*Morus bassanus*)) may fly in long lines across the survey area. At the time of the snapshot, the number of birds in the flock is counted and the distance class is assigned according to the location of the centre of the flock. All the birds are recorded as in transect if the centre of the flock is within the 300 m transect. If the centre of the group is beyond 300 m, they are recorded as not in transect, despite some individuals being within 300 m (see Appendix VII).

4.1.5. Large numbers of birds

When very large numbers of birds are encountered that overwhelm the observer’s ability to count and measure the distance to individual flocks (this does not include typical ship-followers circling the ship), snapshots (of all birds whether in flight or on water) are conducted rather than continuous counts. Snapshot intervals are the same as those used to count flying birds (Table 1). At the time of the snapshot, all the birds that occur within 300 m of the observer (perpendicular to, as well as ahead of the observer) are counted, but the flying birds are not separated from those on the water. Another count does not occur until the next snapshot interval when the ship has travelled another 300 m. Although it is not practical to estimate distance to each bird, you should indicate whether the birds were observed within 300 m (see Section 5.2). If the majority of the birds are in the air, they can be recorded as flying. However, if they appear to be flushing off the surface of the water as the ship approaches, or continuously moving between the water and air, they are recorded as on the water. When such large flocks are recorded in this way, it is important to indicate the change in protocol in the notes. This scenario is a relatively rare occurrence. Most of the time, distance estimates can be made and flying birds can be separated from those observed on the water.

4.1.6. Birds that follow the ship

After recording a flying bird, it is not subsequently recorded again if it is following the ship. The same bird is not recorded on subsequent snapshots, even if it leaves and then re-enters the survey area. When dozens or more birds are following the vessel, it will be impossible to determine which individuals have already been recorded and which have recently joined the ship. For example, Northern Fulmars (*Fulmarus glacialis*) at times circle the ship in large numbers and as far out as the edge of the transect and beyond. In this case, the number of birds following the ship is estimated at regular intervals (i.e., once an hour) and their association as ship followers (code 18; Appendix VI) is recorded. The ship followers are ignored at intervals between counts. If it can be determined that new individuals are joining the flock, these are recorded and their distance from the observer is estimated.

4.2. Surveys from stationary platforms

Observations from stationary platforms (including ships stopped on station or on standby) are conducted using instantaneous counts, or snapshots, of birds within an area that is scanned at regular intervals throughout the day. These surveys will usually last only a few seconds. The survey is conducted from a position outdoors whenever possible, as close to the edge of the platform as permitted. A position near the edge will increase the detection rates of birds, especially for birds that use the waters at the base of the platform. If surveys are being conducted from a stationary platform such as an oil drilling rig, observers should scan from the same location each time in order to increase the comparability among scans.

Surveys are conducted by scanning a 180° arc, giving priority to birds within a 300 m semi-circle (Figure 3). Observers should practice estimating the locations of the various distance bands prior to beginning observations. This is best accomplished with a distance gauge made from a transparent plastic ruler (see Appendix I). This gauge should be kept close at hand to quickly verify bird distances. The area is visually swept only once per scan, from one side to the other, and all birds on the water and in flight are systematically recorded at that time. The distance to birds from the observer is estimated and recorded for all birds (Figure 3). Binoculars and spotting scopes can be used to confirm species identification and other details as necessary.

The same area is surveyed once every hour during the day, regardless if birds are present or not. When the entire width of the 300 m semi-circle is not visible, the observer indicates the limit of visibility on the data sheet. When no birds are detected during a scan, it is important to record “No birds observed” on the record sheet.

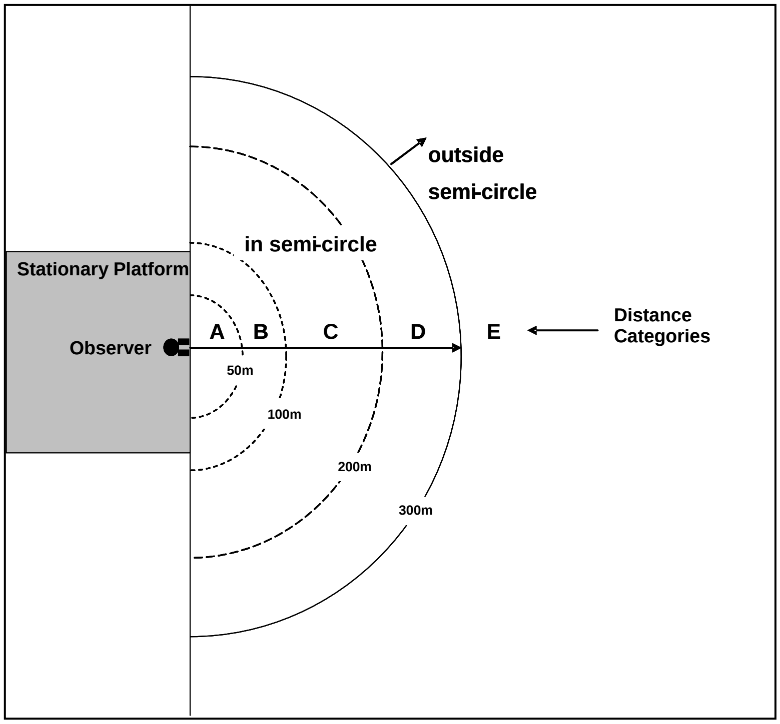

Figure 3. Illustration of survey using a 180° scan, surveying an area 300 m from a stationary observer. All birds observed within this area, whether flying or on the water, are recorded. Birds visible beyond 300 m are also important and are recorded, if at all possible. The distances to all birds are estimated. Birds observed outside the 300 m semi-circle are recorded as not in semi-circle.

5. DATA RECORDING

This section provides detailed information on recording information during each observation period. See Appendix X for example data sheets. Section 5.1 describes the data fields that must be filled in for each 5-minute observation period. Section 5.2 describes the fields recorded for each bird sighting.

5.1 Observation Period Information

It is important to fill in all the fields under the heading "Observation period information" for moving platform surveys, or "Scan information" for stationary surveys at the beginning of each survey. The information collected here may affect which birds are observed and therefore will be important to incorporate into any subsequent analyses.

Company/agency: Seabird observers may be volunteers or contracted through private industry or government agency. Indicate the company, agency or organisation that has requested the surveys (e.g., Canadian Wildlife Service, ExxonMobil, Memorial University).

Platform name and type: Platform type may include seismic ship, offshore supply vessel, fishing boat, research ship, ferry, etc.

Observer(s): Indicate the first and last name of the primary observer. Also record the name of any additional observers assisting with the survey.

Date: Record the date that the survey took place. Use format DD-MMM-YYYY (e.g. 12-Apr-2008) to avoid ambiguity.

Time at start / Time at end: Record the time (using 24 h notation) at the start and end of the observation period. Use Universal Time (UTC) to standardize across regions. Note that the conversion from local time to UTC will be influenced by daylight savings time.

Latitude and longitude at the start and end of the observation period: Indicate position of platform in either decimal degrees (e.g. 47.5185) or degrees and decimal minutes (e.g. 47˚ 31.11´) depending on which format is available to you.

Platform activity: Platform activity may influence observations and should therefore be noted. Activities could include steaming, seismic array active, drilling, off-loading at drilling rig, etc.

Scan type (for stationary platforms only): Conduct a 180˚ scan for all stationary surveys. If part of the survey area is obstructed, indicate the scan angle used.

Scan direction (for stationary platforms only): Indicate the true (not magnetic) bearing when looking straight ahead, at centre of semi-circle.

Visibility: Measure visibility by determining the greatest distance at which you can distinguish objects, ideally black, against the horizon sky with the unaided eye. Under normal atmospheric conditions, visibility depends only on the height above the sea surface from which it is observed (visibility in kilometres = 3.84 * sqrt(height in meters)). For example, on a clear day on a vessel 12 m above the surface, maximum visibility will be 13 km. Visibility will be considerably less during foggy conditions.

Weather conditions: Record the general weather conditions at the time of the survey according to codes in Appendix II. Record the most prominent conditions within the survey area. For example, if there are distant fog patches that do not directly affect the survey conditions, the weather code will be 0 or 1. Alternatively, if there is < 50% cloud cover but you are travelling through fog patches, the weather code will be 2.

Glare conditions: Light reflecting off the surface of the water can often influence bird detection. Record the glare conditions at the time of the survey according to codes in Appendix II.

Sea state code: Sea state codes give an approximate description of current conditions on the surface of the water. Use codes from Appendix III.

Wave height: Estimate wave height (m) from the highest point of a wave (peak) to the lowest point (trough).

Wind speed or force: Indicate wind speed in knots. If observations are from a moving platform, be sure to record the TRUE wind speed, as this takes into account the 'apparent' wind generated from the forward momentum of the vessel. If relative wind speed is the only measurement available, indicate that you are recording relative wind speed so that appropriate adjustments can be made later. If no measurements are available, estimate wind speed using Beaufort codes from Appendix III.

Wind direction: Wind direction is the direction from which a wind originates. If observations are from a moving platform, be sure to record the TRUE wind direction, as this takes into account the 'apparent' wind generated from the forward momentum of the vessel. If relative wind direction is the only measurement available, indicate that you are recording relative wind direction so that appropriate adjustments can be made later. Use ***ND*** (No Direction) if the wind direction is variable or too light to indicate a particular direction.

Ice Type and Concentration: If ice is present during the survey, indicate the type and concentration using codes from Appendix IV. Indicate in the notes if the ice is present only beyond the transect limits.

Platform speed and direction (for moving platforms only): Record the platform speed in knots and the true (NOT magnetic) platform direction. If the platform speed or direction changes significantly during an observation period, terminate the observation period and record the time and position of termination. Start a new observation period, recording the new speed and/or direction.

Observation side (for moving platforms only): Circle whether you are surveying from ***Starboard*** or ***Port***.

Height of eye (meters): Indicate height of observer's eye above the water in meters. This measurement is important to calibrate distance categories (Appendix I) and may need to be measured with a measuring tape or rope.

Outdoors or Indoors: Circle ***Out*** when conducting observations from a position outdoors and ***In*** for indoor observations.

With snapshot? (for moving platforms only): Indicate if snapshot method is being used for birds in flight by circling ***Y*** or ***N***. Under normal circumstances, snapshots should always be used for birds in flight.

Notes: Make note of disturbances or relevant activities in the area, especially if there are large vessels or fishing activities nearby, or if your vessel is sounding the fog horn.

5.2 Bird Information

At a minimum, the species (which can be unknown), count, fly or water, and in transect (or in semi-circle, if doing stationary surveys) fields MUST be filled in for each sighting. Note that some fields are only appropriate for certain species. For example, age and sex will only be recorded for species where this can be determined (e.g., ageing gulls or sexing waterfowl). Priority is given to birds that are in transect, since these are the only birds that are used in density estimates. Birds recorded not in transect or not in semi-circle give us important information on distribution, timing of occurrence, and behaviour, and effort should be made to record them if time permits.

Species: Identify each individual bird seen to species. If this is not possible, identify to genus or family. Record all unknowns, even if they are identified only as "unknown gull" or "unknown bird". See Appendix V for a list of commonly used species codes. See Section 5.2.1 for information on recording mixed species/age flocks. When garbage is encountered within the survey area, it should be recorded as GARB. Marine mammals, fish and sharks should also be recorded if possible.

Count: Record the number of birds in each sighting in the count field. Record homogenous flocks on a single line. For example, a group of 10 Common Murres (*Uria aalge*) close together on the water is recorded in a single row as a flock of 10 and not as 10 individual rows. If large numbers are present, estimate the number as accurately as possible.

Fly or Water?: Indicate whether the bird(s) observed is in flight (***F***) or on the water (***W***). Occasionally you will have a songbird that may land on the ship. We record these as on the ship (***S***). When surveying close to land, birds sitting on land may be recorded as ***L***.

In transect or semi-circle?: Indicate if bird observed is in (***Y***) or out (***N***) of the transect (moving) or semi-circle (stationary). See Section 5.2.2 for more details. Give priority to birds that are in the transect or semi-circle. Record birds seen outside the transect if activity levels permit.

Association and Behaviour: Record one or more association and/or behaviour codes with each bird when appropriate (see Appendix VI for association and behaviour codes, and refer to Camphuysen and Garthe (2004) for further information).

Distance: Record the distance to each bird or flock. This information is used to assess detectability and account for missed birds (see Section 3). For all birds, estimate the perpendicular distance between the bird(s) and the observer (Figure 1). Distance categories are as follows: ***A*** = 0-50 m, ***B*** = 51-100 m, ***C*** = 101-200 m, ***D*** = 201-300 m, and ***E*** = > 300 m. Record flocks of birds as a single unit by recording the distance to the ***centre*** of the flock. For example, if a group is straddling the 300 m boundary with the flock centre located in ***D*** (with some individuals inside and some individuals outside the transect) record **the entire flock** as being in ***D*.** If the flock centre is outside the transect, record the entire flock as distance class ***E***. It is very important to record distance to birds within the 300 m strip, but if this is not possible (i.e., too busy), you may use ***3*** = within 300 m but no distance recorded. Distance ***T*** is used to indicate that the bird or flock was observed on the opposite side of the vessel.

Flight direction: Indicate true heading direction (***N***, ***NE***, ***E***, ***SE***, ***S***, ***SW***, ***W***, ***or NW)*** for birds in flight if they are not associated with the platform. If birds are flying erratically such that no one direction is appropriate, record them as ***ND* (no direction)**. Note that *ND* is not the same as not recording flight direction. For example, if the data field is left blank, flight direction information was not collected for that sighting. However, if *ND* was recorded for the sighting, that particular bird(s) was flying erratically, in circles, etc.

Age: Record age based on plumage, where ***J***(uvenile) = first coat of true feathers acquired before leaving the nest; ***I***(mmature) = the first fall or winter plumage that replaces the juvenile plumage and may be worn for several years (across multiple moults) until reaching adulthood; and ***A***(dult) = all subsequent plumages.

Plumage: Adult plumage can be further categorized as ***B***(reeding) = spring and summer plumage, or ***NB*** (non-breeding) = fall and winter plumage. ***M*** is used to indicate a bird with flight feathers moulting.

Notes: Record other pertinent information such as color phase, unusual behaviours, etc.

5.2.1 Recording mixed groups of birds

Sometimes flocks of birds will contain multiple species or age classes and will require multiple rows on the datasheet (e.g., a flock containing both Great and Sooty Shearwaters (*Puffinus gravis* and *P. griseus*), or a flock of Black-legged Kittiwakes (*Rissa tridactyla*) containing both adult and immature birds). Subsets of the group that share the same morphological and behavioural characteristics are recorded in the same row (e.g., all adult kittiwakes in breeding plumage flying in the same direction). Other individuals from the group that have different characteristics (e.g., juveniles) are recorded in subsequent rows. Draw an arc linking all rows from the group to indicate that they were together (see example in Appendix VII).

5.2.2 For moving platforms, when are birds recorded as in transect?

Whether birds are in transect or not depends on whether they are on the water or in flight. Birds on the surface of the water within 300 m perpendicular distance from the observer are always considered in transect (Figure 1). When visibility is good, birds on the water may be seen up ahead of the platform, perhaps as far as 400 m or 500 m ahead, but still within the 300 m transect. Because these individuals may dive or fly away as a result of the approaching vessel, they should be counted as in transect and their perpendicular distance recorded when they are first detected (unless the observation period will end before the ship reaches them, in which case they are recorded in the next period). Flying birds are only considered in transect if they are observed during a snapshot AND they are physically within the snapshot block (within 300 m to the side and 300 m ahead of the vessel) (Figure 1, Appendix VII).

6. CONCLUSION

The Eastern Canada Seabirds at Sea (ECSAS) monitoring program uses this protocol to collect distribution and abundance information for birds at sea in Atlantic Canada. The protocol follows recommendations for standardized recording techniques (Tasker et al. 1984) that are used in the North Sea and northeastern Atlantic with modifications to allow for the estimation of bird detectability (Buckland et al. 2001). Although we are far from achieving a global standardization of methods, it is our hope that this report will serve as a guide for others conducting pelagic bird surveys in our region and elsewhere so that comparisons among seabird communities can be made. It is our recommendation that before any surveys are conducted, observers have the skills necessary to identify the seabirds in their survey area, and participate in a training program that includes specific instruction on implementing the protocol. Future modifications of the protocol will be necessary as methods are tested and techniques developed, and we encourage any feedback that will improve upon our current survey approach.

7. ACKNOWLEDGEMENTS

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APPENDIX I. Estimating distance categories

The various distance categories can be estimated using the following equation[1]:

$$d_h = 1000 \frac{(ah3838\sqrt{h}) - ahd}{h^2 + 3838d\sqrt{h}}$$

e.g. if $a = 0.730$ m, $h = 12.5$ m, and $d = 300$ m

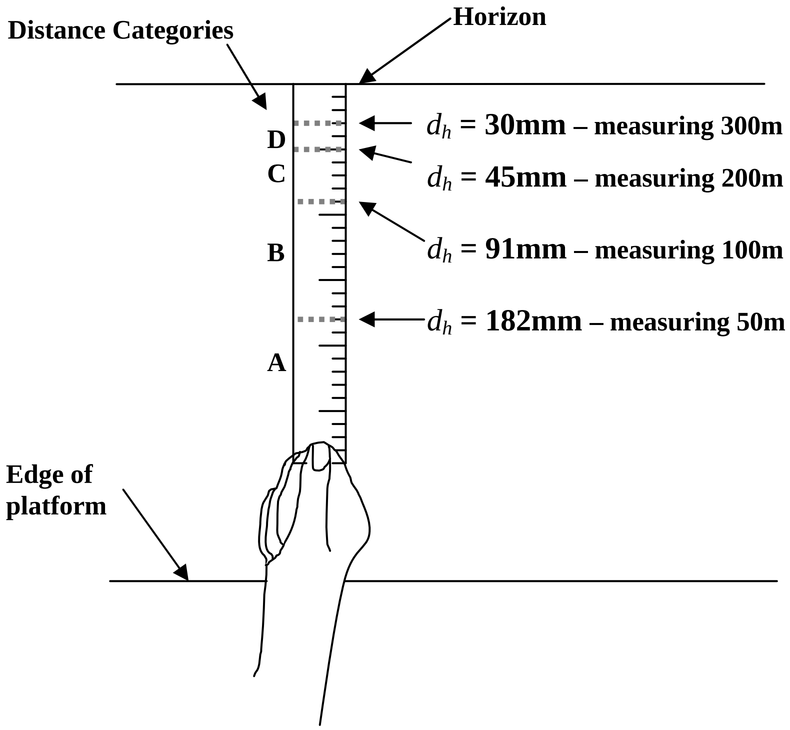
then $d_h = 30.0$ mm

where:

d_h = distance below horizon (mm)
a = distance between the observer's eye and the ruler when observer's arm is fully out-stretched (m)
h = height of the observer's eye above the water at the observation point (m)
d = distance to be estimated (m; a separate calculation is required for each of 50, 100, 200, 300)

Distances are easily estimated using a gauge made from a transparent plastic ruler. A different ruler will be required for each combination of observer arm length (a) and platform height (h). Calculate d_h for the boundary of each distance class (A, B, C, D) and mark them on the ruler (dashed lines in figure). To use the gauge, extend the arm fully and keep the top end of the ruler aligned with the horizon. The dashed lines now demark the distance class boundaries on the ocean surface. Keep the gauge nearby during surveys to quickly verify bird distances.

Measurements for an observer with a = 73 cm and h = 12.5 m:



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[1] Formula derived by J. Chardine, based on Heinemann 1981. A spreadsheet is available from the corresponding author to perform this calculation.

APPENDIX II. Codes for general weather conditions and glare

Code	Description	Explanation
Weather conditions		
0		< 50% cloud cover (with no fog, rain, or snow)
1		> 50% cloud cover (with no fog, rain, or snow)
2		patchy fog
3		solid fog
4		mist/light rain
5		medium to heavy rain
6		fog and rain
7		snow
Glare conditions		
0		none
1		slight/grey
2		bright on the observer’s side of vessel
3		bright and forward of vessel

APPENDIX III. Codes for sea state and Beaufort wind force

Wind Speed (knots)	Sea state code and description	Beaufort wind force and description
0	**0** Calm, mirror-like	**0** calm
01 – 03	**0** Ripples with appearance of scales but crests do not foam	**1** light air
04 – 06	**1** Small wavelets, short but pronounced; crests do not break	**2** light breeze
07 – 10	**2** Large wavelets, crests begin to break; foam of glassy appearance; perhaps scattered white caps	**3** gentle breeze
11 – 16	**3** Small waves, becoming longer; fairly frequent white caps	**4** moderate breeze
17 – 21	**4** Moderate waves with more pronounced form; many white caps; chance of some spray	**5** fresh breeze
22 – 27	**5** Large waves formed; white foam crests more extensive; probably some spray	**6** strong breeze
28 – 33	**6** Sea heaps up; white foam from breaking waves blows in streaks in direction of wind	**7** near gale
34 – 40	**6** Moderately high long waves; edge crests break into spindrift; foam blown in well-marked streaks in direction of wind	**8** gale
41 – 47	**6** High waves; dense streaks of foam in direction of wind; crests of waves topple and roll over; spray may affect visibility	**9** strong gale
48 – 55	**7** Very high waves with long overhanging crests; dense foam streaks blown in direction of wind; surface of sea has a white appearance; tumbling of sea is heavy; visibility affected	**10** storm
56 - 63	**8** Exceptionally high waves; sea is completely covered with white patches of foam blown in direction of wind; edges blown into froth; visibility affected	**11** violent storm
64 +	**9** Air filled with foam and spray; sea completely white with driving spray; visibility seriously affected	**12** hurricane

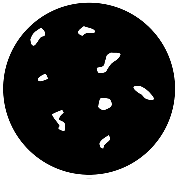
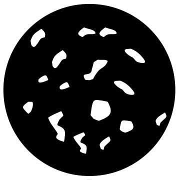
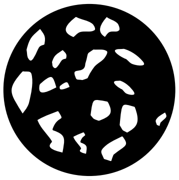
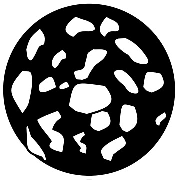
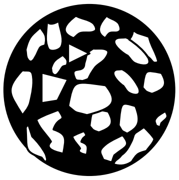
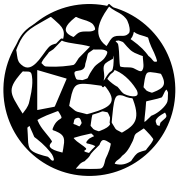
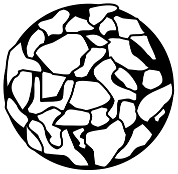
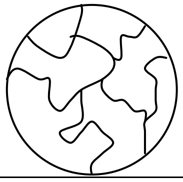
APPENDIX IV. Codes for ice conditions

Adapted from NOAA: Observers Guide to Sea Ice

Sea Ice Forms

Code	Name	Description
0	New	small, thin, newly formed, dinner plate-sized pieces
1	Pancake	rounded floes 30 cm - 3 m across with ridged rims
2	Brash	broken pieces < 2 m across
3	Ice Cake	level piece 2 - 20 m across
4	Small Floe	level piece 20 - 100 m across
5	Medium Floe	level piece 100 -500 m across
6	Big Floe	level, continuous piece 500 m - 2 km across
7	Vast Floe	level, continuous piece 2 - 10 km across
8	Giant Floe	level, continuous piece > 10 km across
9	Strip	a linear accumulation of sea ice < 1 km wide
10	Belt	a linear accumulation of sea ice from 1 km to over 100 km wide
11	Beach Ice or Stamakhas	irregular, sediment-laden blocks that are grounded on tidelands, repeatedly submerged, and floated free by spring tides
12	Fast Ice	ice formed and remaining attached to shore

Sea Ice Concentration

Code	Concentration	Description	
0	< one tenth	"open water"	
1	two-three tenths	"very open drift"	
2	four tenths	"open drift"	
3	five tenths	"open drift"	
4	six tenths	"open drift"	
5	seven to eight tenths	"close pack"	
6	nine tenths	"very close pack"	
7	ten tenths	"compact"	

APPENDIX V. Species codes for birds seen in Eastern Canada

Common name	Species code	Latin name
COMMON, REGULAR OR FREQUENTLY SEEN SPECIES		
Northern Fulmar	NOFU	*Fulmarus glacialis*
Great Shearwater	GRSH	*Puffinus gravis*
Manx Shearwater	MASH	*Puffinus puffinus*
Sooty Shearwater	SOSH	*Puffinus griseus*
Wilson's Storm-Petrel	WISP	*Oceanites oceanicus*
Leach‘s Storm-Petrel	LESP	*Oceanodroma leucorhoa*
Northern Gannet	NOGA	*Morus bassanus*
Red Phalarope	REPH	*Phalaropus fulicaria*
Red-necked Phalarope	RNPH	*Phalaropus lobatus*
Long-tailed Jaeger	LTJA	*Stercorarius longicaudus*
Parasitic Jaeger	PAJA	*Stercorarius parasiticus*
Pomarine Jaeger	POJA	*Stercorarius pomarinus*
Great Skua	GRSK	*Stercorarius skua*
Herring Gull	HERG	*Larus argentatus*
Iceland Gull	ICGU	*Larus glaucoides*
Glaucous Gull	GLGU	*Larus hyperboreus*
Great Black-backed Gull	GBBG	*Larus marinus*
Black-legged Kittiwake	BLKI	*Rissa tridactyla*
Common Murre	COMU	*Uria aalge*
Thick-billed Murre	TBMU	*Uria lomvia*
Razorbill	RAZO	*Alca torda*
Dovekie	DOVE	*Alle alle*
Atlantic Puffin	ATPU	*Fratercula arctica*
SPECIES MORE COMMONLY SEEN INSHORE		
Common Loon	COLO	*Gavia immer*
Red-throated Loon	RTLO	*Gavia stellata*
Red-necked Grebe	RNGR	*Podiceps grisegena*
Horned Grebe	HOGR	*Podiceps auritus*
Great Cormorant	GRCO	*Phalacrocorax carbo*
Double-crested Cormorant	DCCO	*Phalacrocorax auritus*
Greater Scaup	GRSC	*Aytha marila*
Common Eider	COEI	*Somateria mollissima*
Harlequin Duck	HARD	*Histrionicus histrionicus*
Long-tailed Duck	LTDU	*Clangula hyemalis*
Surf Scoter	SUSC	*Melanitta perspicillata*
Black Scoter	BLSC	*Melanitta nigra*
White-winged Scoter	WWSC	*Melanitta fusca*
Red-breasted Merganser	RBME	*Mergus serrator*
Black Guillemot	BLGU	*Cepphus grylle*

Common name	**Species code**	**Latin name**
INFREQUENTLY OR RARELY SEEN SPECIES		
Cory’s Shearwater	COSH	*Calonectris diomedea*
Audubon’s Shearwater	AUSH	*Puffinus lherminieri*
Lesser Scaup	LESC	*Aythya affinis*
King Eider	KIEI	*Somateria spectabilis*
South Polar Skua	SPSK	*Stercorarius maccormicki*
Bonaparte's Gull	BOGU	*Larus philadelphia*
Ivory Gull	IVGU	*Pagophila eburnea*
Black-headed Gull	BHGU	*Larus ridibundus*
Laughing Gull	LAGU	*Larus articilla*
Ring-billed Gull	RBGU	*Larus delawarensis*
Lesser Black-backed Gull	LBBG	*Larus fuscus*
Sabine’s Gull	SAGU	*Xema sabini*
Common Tern	COTE	*Sterna hirundo*
Arctic Tern	ARTE	*Sterna paradisaea*
Roseate Tern	ROTE	*Sterna dougallii*
CODES FOR BIRDS IDENTIFIED TO FAMILY OR GENUS		
Unknown Bird	UNKN	
Unknown Shearwater	UNSH	*Puffinus* or *Calonectris*
Unknown Storm-Petrel	UNSP	Hydrobatidae
Unknown Duck	UNDU	Anatidae
Unknown Eider	UNEI	*Somateria*
Unknown Phalarope	UNPH	*Phalaropus*
Unknown Jaeger	UNJA	*Stercorarius*
Unknown Skua	UNSK	*Stercorarius*
Unknown Gull	UNGU	Laridae
Unknown Tern	UNTE	*Sternidae*
Unknown Alcid	ALCI	Alcidae
Unknown Murre or Razorbill	MURA	*Uria* or *Alca*
Unknown Murre	UNMU	*Uria*

APPENDIX VI. Codes for associations and behaviours

From Camphuysen and Garthe (2004). Choose one or more as applicable.

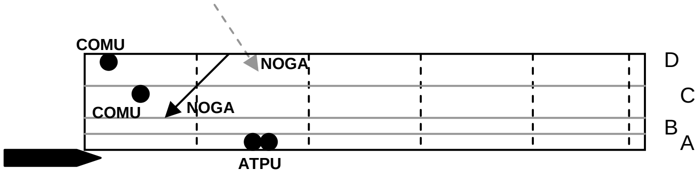
Code	Description
Association	
10	Associated with fish shoal
11	Associated with cetaceans
13	Associated with front (often indicated by distinct lines separating two water masses or concentrations of flotsam)
14	Sitting on or near floating wood
15	Associated with floating litter (includes plastic bags, balloons, or any garbage from human source)
16	Associated with oil slick
17	Associated with sea weed
18	Associated with observation platform
19	Sitting on observation platform
20	Approaching observation platform
21	Associated with other vessel (excluding fishing vessel; see code 26)
22	Associated with or on a buoy
23	Associated with offshore platform
24	Sitting on offshore platform
26	Associated with fishing vessel
27	Associated with or on sea ice
28	Associated with land (e.g., colony)
50	Associated with other species feeding in same location

Code	Description	Explanation
Foraging behaviour		
30	Holding or carrying fish	carrying fish towards colony
32	Feeding young at sea	adult presenting prey to attended chicks (e.g., auks) or juveniles (e.g., terns)
33	Feeding	method unspecified (see behaviour codes 39,40,41,45)
36	Aerial pursuit	kleptoparisitizing in the air
39	Pattering	low flight over the water, tapping the surface with feet while still airborne (e.g., storm-petrels)
40	Scavenging	swimming at the surface, handling carrion
41	Scavenging at fishing vessel	foraging at fishing vessel, deploying any method to obtain discarded fish and offal; storm-petrels in the wake of trawlers picking up small morsels should be excluded
44	Surface pecking	swimming birds pecking at small prey (e.g., fulmar, phalaropes, skuas, gulls)
45	Deep plunging	aerial seabirds diving under water (e.g., gannets, terns, shearwaters)
49	Actively searching	persistently circling aerial seairds (usually peering down), or swimming birds frequently peering (and undisturbed by observation platform) underwater for prey
General behaviour		
60	Resting or apparently sleeping	reserved for sleeping seabirds at sea
64	Carrying nest material	flying with seaweed or other material; not to be confused with entangled birds
65	Guarding chick	reserved for auks attending recently fledged chicks at sea
66	Preening or bathing	birds actively preening feathers or bathing
Distress or mortality		
71	Escape from ship (by flying)	escaping from approaching observation platform
90	Under attack by kleptoparasite	bird under attack by kleptoparasite in an aerial pursuit, or when handling prey at the surface
93	Escape from ship (by diving)	escaping from approaching observation platform
95	Injured	birds with clear injuries such as broken wings or bleeding wounds
96	Entangled in fishing gear or rope	birds entangled with rope, line, netting or other material (even if still able to fly or swim)
97	Oiled	birds contaminated with oil
98	Sick/unwell	weakened individuals not behaving as normal, healthy birds, but without obvious injuries
99	Dead	bird is dead

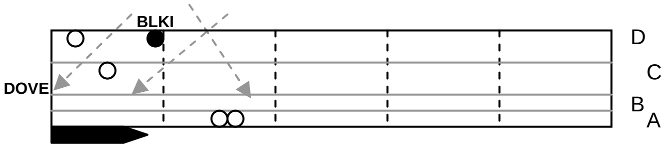
APPENDIX VII. Example 5 min survey from a moving platform[†]

See associated datasheet on pg. 30: We are on a ship travelling east at 10 knots, so in 5 minutes we will travel a distance of approximately 1.5 km. Based on the speed of the vessel, we will conduct a snapshot for flying birds every minute (see Table 1), or 5 times during the survey, and record flying birds detected between snapshots as NOT in transect. In the diagrams that follow, birds on water are represented by dots and flying birds by arrows (birds are at the position of the arrowhead). The vertical dashed lines in the diagrams indicate the boundaries of the 300 m snapshot blocks. Remember, we record the perpendicular distance to all birds.

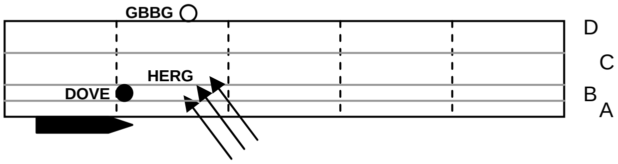
a) We begin the observation period at 11:00 with a snapshot of the flying birds and a count of the birds we see on the water. We see 2 separate adult Northern Gannets flying, although we only count one as in transect, at distance C, as the other is more than 300 m in front of the vessel (at distance D). We also see 2 Common Murres on the water to the port side of the vessel, at distances C and D. These are recorded as in transect. We can also see 2 puffins together on the water, more than 300 m in front of the vessel. We will also count these as in transect, although we will be careful not to count them again as we get closer.



b) Now we are about 30 seconds into the 5 min observation period, **in between snapshot counts**. We have already counted the 2 murres and 2 puffins on the water (shown in the figure as open circles), but an adult Black-legged Kittiwake has appeared on the water at distance D, and we add this to our list as in transect. Despite the appearance of a flying Dovekie within 300 m of the vessel at distance C, we do not count it as in transect because we are between snapshots. We add the Dovekie to our list but indicate that it is NOT in transect.

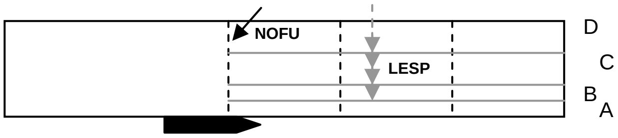


c) At minute 1, we take another snapshot count of flying birds. A flock of 3 Herring Gulls is seen traveling NW. The centre of the flock is at distance B. We also see one Dovekie on the water at distance B, and one Great Black-backed Gull outside 300 m (distance category E). These are all in transect except for the gull at distance E.

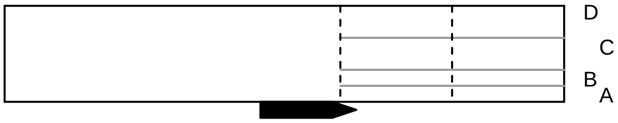


[†] Adapted from Tasker et al. 1984.

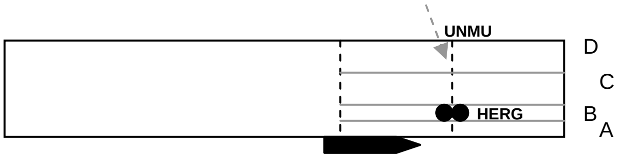
d) At minute 2, we perform another snapshot and count one flying Northern Fulmar in transect at distance D travelling SW. We record the flock of 4 Leach's Storm-Petrels flying south ahead of the vessel (at distance C) but do NOT count them as in transect as they are beyond 300 m.



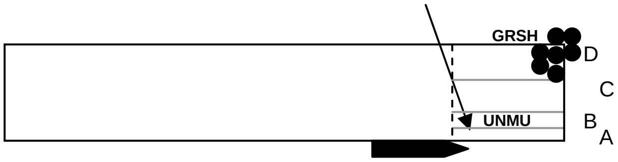
e) At minute 3 we conduct another snapshot. No new birds are observed, so nothing new is written on our data sheet.



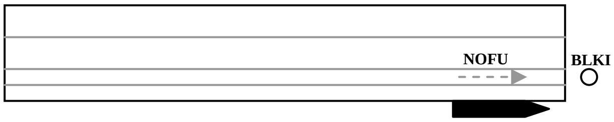
f) At 3:42, a murre of unknown species is observed flying but we DO NOT count it as in-transect because we are **between snapshots**. We will record it as NOT in transect. We record the 2 Herring Gulls feeding (behaviour code 44) up ahead on the water, both in transect at distance B. Because one is a juvenile and one is an adult, we enter them on separate datasheet rows, linking the two with an arc in the left margin.



g) At minute 4, our next snapshot takes place and we note that the unknown murre that we saw flying earlier (see frame f) can now be recorded as in transect at distance B, as it is within 300 m of the vessel AND observed during the snapshot. If we know for certain that this is the same individual we previously recorded as NOT in transect (frame f), we can cross the previous observation out. If we are not certain that this is the same individual we do not cross anything out. There is also a large flock of 200 Great Shearwaters on the water near the edge of the 300 m transect. Since the centre of the group is within the transect, at distance D, we count ALL the shearwaters as being at distance D. If the centre of the group had been beyond 300 m, we would have recorded them as outside the transect at distance E, despite some individuals being in the transect.



h) As we approach the end of the 5 min observation period, we record a Northern Fulmar that is following us (at distance B), but has not been previously recorded. We record it as NOT in transect since we are not at a snapshot point. Remember, you must record ship-followers as "associated with platform" (code 18). We do not include the kittiwake we can see ahead of the vessel, because by the time we reach it, the 5 min observation period will be over. This bird will be counted in the next period.



Example datasheet of a 5 min survey from a moving platform

Observation Period Information:

Company/agency	**CWS**		Sea state code	**3**
Platform name and type	**Hudson, DFO Research**		Wave height (m)	**1**
Observer (s)	**Carina Gjerdrum**		True wind speed [✓ (knots)] **OR** Beaufort code	**12**
Date (DD/MMM/YYYY	**24 May 2007**		True wind direction (deg)	**93˚**
Time at start (UTC)	**11:00**		Ice type code	**0**
Time at end (UTC)	**11:05**		Ice concentration code	**0**
Latitude at start / end	**42˚46.307**	**42˚45.803**	True platform speed (knots)	**10.0**
Longitude at start / end	**-61˚59.156**	**-61˚58.233**	True platform direction (deg)	**191˚**
Platform activity	**Steaming**		Observation side	Starboard [✓ Port]
Visibility (km)	**13.5**		Height of eye (m)	**12.3**
Weather code	**0**		Outdoors or Indoors	Out or [✓ In]
Glare conditions code	**1**		Snapshot used?	[✓ Yes] or No

Notes:

Bird Information: *this field <u>must</u> be completed for each record

	* Species	* Count	* Fly or Water?	* In transect?	* Distance[1]	Assoc.	Behav.	Flight Direc.[2]	Age[3]	Plum.[4]	Sex	Comments
a)	NOGA	1	F	Y	C			SW	A			
	NOGA	1	F	N	D			SE	A			
	COMU	1	W	Y	C							
	COMU	1	W	Y	D							
	ATPU	2	W	Y	A							
b)	BLKI	1	W	Y	D				A			
	DOVE	1	F	N	C			SW				
c)	HERG	3	F	Y	B			NW				
	DOVE	1	W	Y	B							
	GBBG	1	W	N	E							
d)	NOFU	1	F	Y	D			SW				
	LESP	4	F	N	C			S				
f)	UNMU	1	F	N	D			SE				
	HERG	1	W	Y	B		44		A			
	HERG	1	W	Y	B		44		J			
g)	UNMU	1	F	Y	B			SE				
	GRSH	200	W	Y	D							
h)	NOFU	1	F	N	B	18						

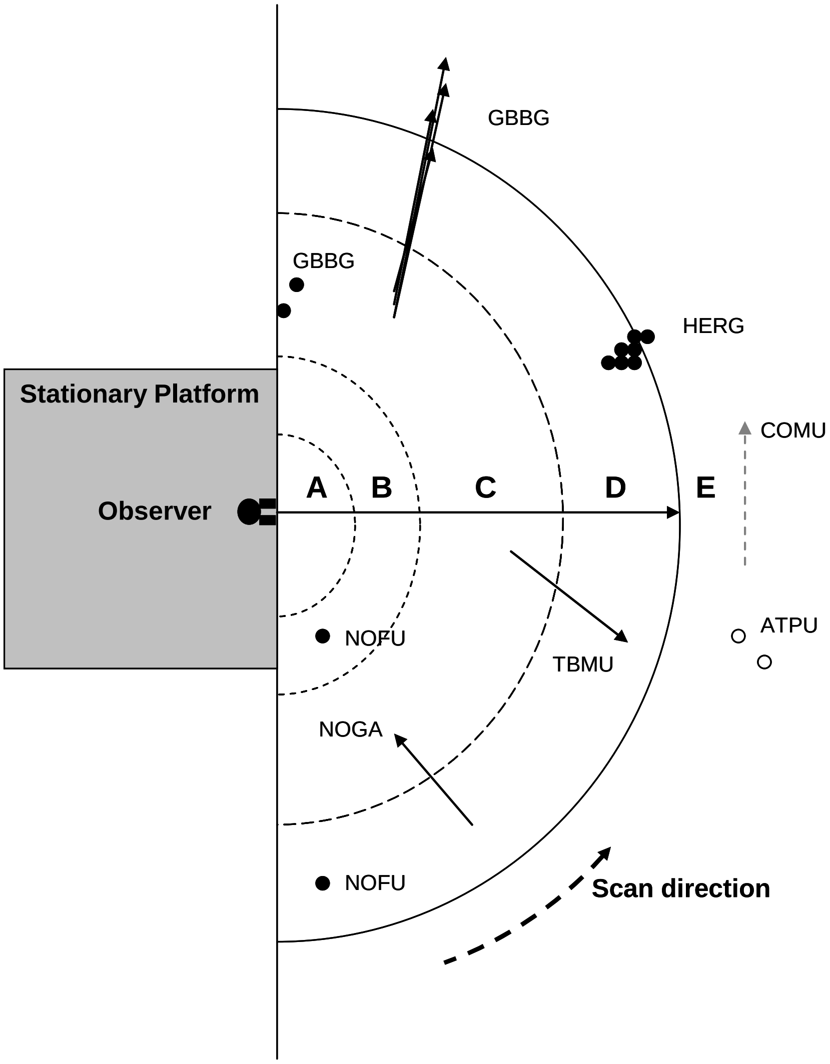
[1] ***A*** = 0-50m, ***B*** = 51-100m, ***C*** = 101-200m, ***D*** = 201-300m, ***E*** = > 300m, ***3*** = within 300m but no distance recorded.

[2] Indicate flight direction (***N***, ***NE***, ***E***, ***SE***, ***S***, ***SW***, ***W***, or ***NW***); ***ND*** = no apparent direction

[3] ***J***(uvenile), ***I***(mmature), or ***A***(dult); [4] ***B***(reeding), ***NB***(non-breeding), ***M***(oult)

APPENDIX VIII. Example survey from a stationary platform

See associated datasheet on pg. 33: Before we begin the scan, we record the required Scan Information at the top of the datasheet. We are facing east and about to conduct our first survey of the day from an offshore oil platform. We have estimated the distance from where we are standing out to 50 m, 100 m, 200 m, and 300 m using our ruler gauge created with the formula outlined in Appendix I. We will now visually scan a 180^o arc, counting all birds observed and estimating their distance from the platform. Before we begin the scan, we record the required Observation Period Information at the top of the datasheet. The survey begins on the right hand side of the semi-circle. In the diagram that follows, birds on water are represented by dots and flying birds by arrows (birds are at the position of the arrowhead).



a) A Northern Fulmar sits on the water approximately 250 m away from us. Another sits within 100 m of us. We add both of these as separate entries on the datasheet.

b) An adult Northern Gannet is flying towards us at distance C and we record it as in semi-circle.

c) We observe a flying Thick-billed Murre travelling southeast, and we record it as in semi-circle at distance D.

d) We can see 2 Atlantic Puffins beyond 300 m sitting on the water. We record them on the datasheet in distance E but note that they are NOT in the semi-circle.

e) We also see a Common Murre flying north beyond 300 m and record it as NOT in semi-circle at distance E.

f) A flock of 7 Herring Gulls is observed at the edge of the 300 m semi-circle. Because the centre of the group is within the semi-circle, at distance D, we count ALL the gulls as being at distance D. If the centre of the group had been beyond 300 m, we would have recorded them as outside the semi-circle at distance E, despite some individuals being in the semi-circle.

g) Four Great Black-backed Gulls are flying north, away from the platform. Since the centre of the flock is outside the semi-circle, these individuals are recorded as outside the semi-circle at distance E (see Section 4.1.4, ***Lines of Flying Birds***)

h) Two additional Great Black-backed Gulls are sitting in the water feeding at distance C. The code for feeding behaviour is ‘33’ (see Appendix VI). Because one is an immature and one is an adult, we enter them in two datasheet rows, linking the two with an arc in the left margin.

Example datasheet for a survey from a stationary platform

Scan Information:

Company/agency	**CWS**	Weather code	**1**
Platform name and type	**Terra Nova FPSO**	Glare conditions code	**0**
Observer (s)	**Carina Gjerdrum**	Sea state code	**3**
Date (DD/MMM/YYYY)	**13 April 2007**	Wave height (m)	**1**
Time at start (UTC)	**0800**	True wind speed (knots) **OR** Beaufort code	**12**
Latitude	**46˚45.000**	True wind direction (deg)	**93˚**
Longitude	**-48˚46.799**	Ice type code	**0**
Platform activity	**Anchored offshore**	Ice concentration code	**0**
Scan type	**[✓ 180º] or other (specify:)**	Height of eye (m)	**33 m**
Scan direction	**East**	Outdoors or Indoors	Out or [✓ In]
Visibility (km)	**10 km**		

Notes:

Bird Information: *this field <u>must</u> be completed for each record

	* Species	* Count	* Fly or Water?	* In semi-circle?	* Distance[1]	Assoc.	Behav.	Flight Direc.[2]	Age[3]	Plum.[4]	Sex	Comments
a)	NOFU	1	W	Y	D							
	NOFU	1	W	Y	B							
b)	NOGA	1	F	Y	C			NW	A			
c)	TBMU	1	F	Y	D			SE				
d)	ATPU	2	W	N	E							
e)	COMU	1	F	N	E			N				
f)	HERG	7	W	Y	D							
g)	GBBG	4	F	N	E			N				
h)	GBBG	1	W	Y	C		33		I			
	GBBG	1	W	Y	C		33		A			

[1] ***A*** = 0-50m, ***B*** = 51-100m, ***C*** = 101-200m, ***D*** = 201-300m, ***E*** = > 300m, ***3*** = within 300m but no distance recorded.

[2] Indicate flight direction (***N***, ***NE***, ***E***, ***SE***, ***S***, ***SW***, ***W***, or ***NW***); ***ND*** = no apparent direction

[3] ***J***(uvenile), ***I***(mmature), or ***A***(dult); [4] ***B***(reeding), ***NB***(non-breeding), ***M***(oult)

APPENDIX IX. Check-list of materials required while conducting seabird surveys

☐ Multiple pens or sharp pencils **(required)**

☐ Multiple copies of blank recording sheets and clipboard **(required)**

☐ Binoculars **(required)**

☐ Watch or clock **(required)** - with countdown timer that can beep on snapshot intervals

☐ Global Positioning System (GPS) to determine vessel position, speed and direction plus extra batteries **(required)**

☐ Compass or GPS to determine flight direction of birds **(required)**

☐ Copy of protocol (**required**)

☐ Seabird identification guide (**required**)

☐ Transparent ruler to determine distances (**required**)

☐ Steel toed boots (**required** for most vessels)

☐ Security and medical certificates (**required** for most vessels)

☐ Notebook (recommended)

☐ Warm and waterproof clothing (recommended)

☐ Calculator or Excel spreadsheet[†] for equation in Appendix I to determine observation distances (recommended)

☐ Laptop for data entry (recommended). Software is available for data entry from corresponding author.

[†] An Excel spreadsheet that automatically performs these calculations is available from the corresponding author.

APPENDIX X. Blank record sheets for moving and stationary platforms

Record sheet for a moving platform survey

Observation Period Information:

Company/agency			Sea state code	
Platform name and type			Wave height (m)	
Observer (s)			True wind speed (knots) **OR** Beaufort code	
Date (DD/MMM/YYYY)			True wind direction (deg)	
Time at start (UTC)			Ice type code	
Time at end (UTC)			Ice concentration code	
Latitude at start / end			True platform speed (knots)	
Longitude at start / end			True platform direction (deg)	
Platform activity			Observation side	Starboard Port
Visibility (km)			Height of eye (m)	
Weather code			Outdoors or Indoors	Out or In
Glare conditions code			Snapshot used?	Yes or No

Notes:

Bird Information: *this field must be completed for each record

* Species	* Count	* Fly or Water?	* In transect?	* Distance[1]	Assoc.	Behav.	Flight Direc.[2]	Age[3]	Plum.[4]	Sex	Comments

[1] ***A*** = 0-50m, ***B*** = 51-100m, ***C*** = 101-200m, ***D*** = 201-300m, ***E*** = > 300m, ***3*** = within 300m but no distance recorded.

[2] Indicate flight direction (***N***, ***NE***, ***E***, ***SE***, ***S***, ***SW***, ***W***, or ***NW***); ***ND*** = no apparent direction

[3] ***J***(uvenile), ***I***(mmature), or ***A***(dult); [4] ***B***(reeding), ***NB***(non-breeding), ***M***(oult)

Record sheet for a stationary platform survey

Scan Information:

Company/agency		Weather code	
Platform name and type		Glare conditions code	
Observer (s)		Sea state code	
Date (DD/MMM/YYYY)		Wave height (m)	
Time at start (UTC)		True wind speed (knots) **OR** Beaufort code	
Latitude		True wind direction (deg)	
Longitude		Ice type code	
Platform activity		Ice concentration code	
Scan type	180º or other (specify:)	Height of eye (m)	
Scan direction		Outdoors or Indoors	Out or In
Visibility (km)			

Notes:

Bird Information:

*this field <u>must</u> be completed for each record

* Species	* Count	* Fly or Water?	* In semi-circle?	* Distance[1]	Assoc.	Behav.	Flight Direc.[2]	Age[3]	Plum.[4]	Sex	Comments

[1] ***A*** = 0-50m, ***B*** = 51-100m, ***C*** = 101-200m, ***D*** = 201-300m, ***E*** = > 300m, ***3*** = within 300m but no distance recorded.

[2] Indicate flight direction (***N***, ***NE***, ***E***, ***SE***, ***S***, ***SW***, ***W***, or ***NW***); ***ND*** = no apparent direction

[3] ***J***(uvenile), ***I***(mmature), or ***A***(dult); [4] ***B***(reeding), ***NB***(non-breeding), ***M***(oult)

www.ec.gc.ca

Additional information can be obtained at:

Environment Canada
Inquiry Centre
10 Wellington Street, 23rd Floor
Gatineau QC K1A 0H3
Telephone: 1-800-668-6767 (in Canada only) or 819-997-2800
Fax: 819-994-1412
TTY: 819-994-0736
Email: enviroinfo@ec.gc.ca