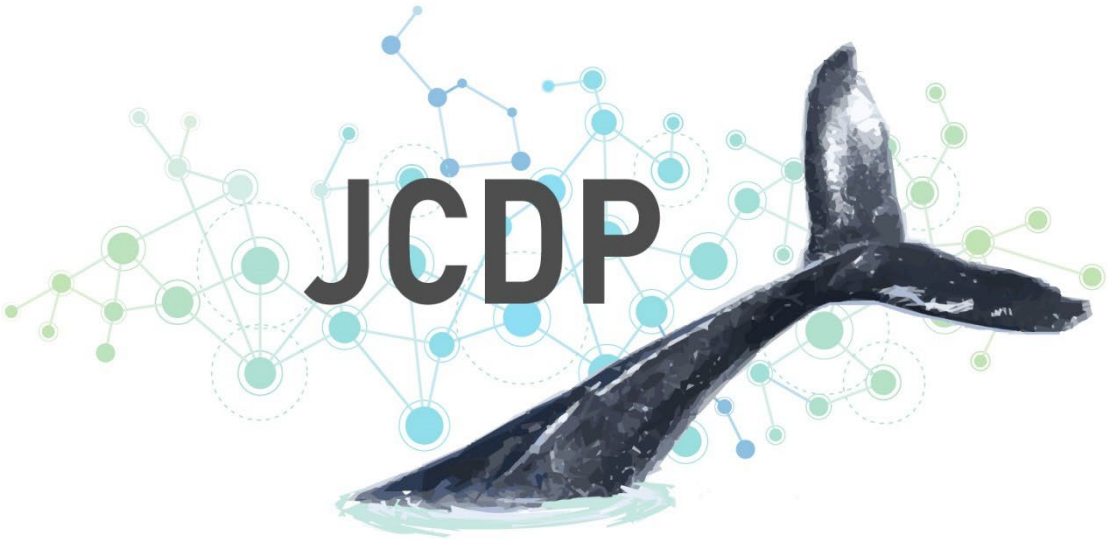

Joint Cetacean Data Programme

Data Collection Guidance

Collecting JCDP Compliant Cetacean Survey Data

Version 1
June 2022

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This report should be cited as:
Joint Cetacean Data Programme. 2022. JCDP Data Collection Guidance: Collecting JCDP Compliant Cetacean Survey Data (version 1). JNCC, Peterborough

Acknowledgments:
The Joint Cetacean Data Programme was developed between 2019 and 2022, funded by the Department of Environment, Food and Rural Affairs (Defra). The project was managed by JNCC with development and hosting of the Data Portal by ICES.

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Funded by

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Contributors to the JCDP can be found on the JCDP Information Hub https://jncc.gov.uk/our-work/jcdp-contributors/

From 2022 the JCDP is managed by the ICES Working Group for the Joint Cetacean Data Programme (WGJCDP).

Joint Cetacean Data Programme

Data Collection Guidance
Collecting JCDP compliant cetacean survey data

Contents

1. Overview

The Joint Cetacean Data Programme (JCDP) is a platform for collation, storage and access of cetacean data collected at sea via ship-based or aerial observer/digital methodologies. The JCDP aims to facilitate access to standardised cetacean survey data by collating the existing cetacean evidence base into a single resource. It is a growing resource, aiming to enable best use of all available data of comparable types from which to carry out analyses at relevant spatial and temporal scales to inform cetacean research, management, policy and conservation.

JCDP Cetacean Data Portal: https://cetaceans.ices.dk/

JCDP Information Hub: https://jncc.gov.uk/our-work/joint-cetacean-data-programme/

One of the key objectives of the JCDP is to work with data providers to synthesise a standardised approach in which data are collected and stored, to support collation of data into a central JCDP database. Combining cetacean datasets from the existing evidence base has proven to be highly effective in enabling the assessment of cetacean populations across wide areas and appropriate time periods, increasing the value of these data. This has been demonstrated by data analysis exercises such as the JNCC-led Joint Cetacean Protocol and the Marine Ecosystems Research Programme.

2. Purpose of this document

This document outlines the main principals for transect sampling for cetacean species and outlines field method recommendations which should be considered when designing a cetacean survey method which meets the JCDP standard. There is supplementary guidance for survey design which can be applied on a voluntary basis, it is not essential for contributors to the JCDP to follow this guidance. However, contributors to the JCDP are required to meet the agreed JCDP Data Standard.

3. Introduction

Mobile marine species, including cetaceans, offer a considerable challenge when attempting to assesses abundance and distribution. Cetaceans can be cryptic and visual survey methods must take into account the limited opportunities for sightings, i.e. when the animal surfaces to breathe. There are several well establish approaches and methods used to for gathering data and monitoring cetacean populations using visual sightings such as transect sampling, photo identification and records of live and dead animals. These methods can be costly in terms of the resources needed to run effective field surveys, but offer a wealth of valuable data which underpins population abundance estimates and distribution patterns (Reid, Evans and Northridge, 2003; Waggitt *et al.*, 2020; Hammond *et al.*, 2021).

However, there are additional methods developed and used for collecting data on cetacean populations, including acoustic monitoring with mobile or static devices, recording and sampling from strandings or biopsies from live animals, remote monitoring using satellite imagery or telemetry tracking using specialised tags. These methods are outside of the scope of this report and the JCDP.

The JCDP currently focuses on data collected following transect methodologies based on either vessel or aerial platforms, and these methods are the focus of this document. Transect methods are based on the principle of traveling along set transects within a study area to count all individuals of a population encountered along the transects, then the total

population can be calculated, for example using Distance modelling approaches (Miller, 2021) .

For cryptic species, such as cetaceans, where it is impossible to see all individuals on the transect, we also need to calculate the proportion of animals encountered vs those that were likely missed using a model called a 'detection function'. This model estimates the number of animals missed within the transect based on the decrease of sightings as distance from the transect line itself increases.

There are a number of assumptions that are important to understand when designing a cetacean survey;

- All animals encountered on the transect line are recorded, as this value is key to fitting an accurate detection function.
  There are field methods to increase the probability of this assumption being met, for example the use of dual observers, with both observing the transect line.

- Transect sampling assumes that the transect lines are placed randomly in respect to the assumed population distribution.
  For example, coastal species are likely to have higher density closer to shore than in offshore waters, so to accommodate this the transect lines should be placed perpendicular (i.e., across the density gradient) to the shore so the distribution pattern is captured along each transect line. Clusters of animals, such as pods, are recorded as both a group and an estimate of the number of individuals within the pod.
  However, this assumption may be relaxed if spatial modelling methods are applied.

- A transect survey is a 'snapshot in time' of the population, so movement of animals is assumed to not have an effect.
  In reality this is practically impossible as surveys are completed over time (whether this is over a day or over a week, etc.) and animals are mobile. The resulting bias caused by random animal movement can be accounted for within the model. However, movement caused by the observer activities can be inflated (if individuals move towards the survey vessel) or reduced (if animals move to avoid the survey vessel). There are field methods that help to meet this assumption, such as only counting animals ahead of the ship before they are influenced by observer presence and recording animals at distance where possible without losing accuracy.

- Accuracy of measurements can be a source of bias if there are systematic errors such as rounding the distance or angles of the encounters.
  The use of tools such as angle boards, distance sticks and range-finders can help to minimise this during field surveys and training of observers.

These assumptions are explored in more detail below.

4. Principals of Cetacean transect surveys

Cetacean surveys collecting data that can be used to estimate abundance are primarily based on moving platforms such as boats/vessels or aerial craft. There are also methodologies based on a single point e.g., land-based survey, but these data have limitations in estimating abundance, particularly in terms of spatial coverage.

The most common survey design used is called 'line transect survey', where the survey platform surveys along a pre-determined route (transect line) transecting through the area of interest, and information is recorded about every animal sighted, such as the distance the animal is from the observer, the number of animals seen, etc. These data are then processed and analysed to calculate the abundance estimate of that species within the study area. However, line transect survey analysis assumes that all animals within the transect search area are recorded therefore would lead to underestimates of density and abundance for more cryptic species, as it is more likely that animals may be missed.

4.1. Distance sampling

In the context of estimating cetacean abundance or density, not all animals present within the transect search area will be detected, such as when they are underwater or may have been missed by the observers. Distance sampling takes these missed animals into account when calculating abundance estimates, therefore distance sampling is a method that is widely adopted for cetacean species. This method records additional information about the distance of the sighting from the observer (or transect line) which is used to estimate the number of animals within the transect search area which were not recorded, as well as those recorded.

Distance sampling method acknowledges that the probability the detecting an animal decrease as distance from the observer increases. A histogram of the number of sightings against the distances of the sightings is the basis for calculating the detection functions; a model of the probability of detecting an animal, given its distance from the transect centreline. The detection function is incorporated in the analysis, giving a truer density and abundance estimate.

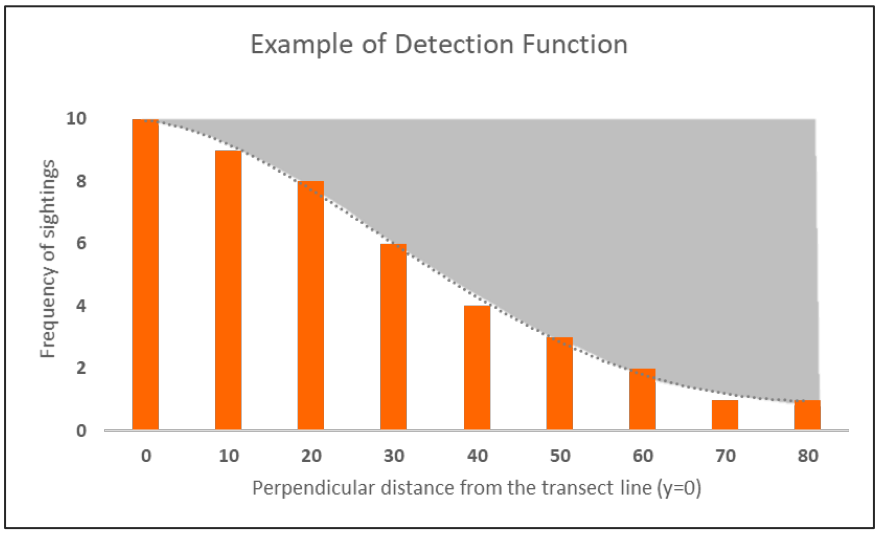

Figure 1: An example histogram of decreasing frequency of sightings as the distance from the transect line increases; this relationship is modelled by the detection function (grey dashed line). The grey area above the detection function illustrates the proportion of animals in the transect area not recorded during the survey (Buckland, et al 2015).

Distance sampling can be done with other methods such as strip transects (where all animals within a specific distance of the transect line are counted without the distance from the line being recorded) or point transects (where the number of animals within a specified radius of pre-preterminal survey points located throughout the area of interest). However, these methods are less often applied for cetacean surveys.

4.2. Key assumptions

Distance analyses make some assumptions about the species and the data to be able to determine the estimated abundance. Minimising bias and the implications of these assumptions is key to designing an effective survey and gathering quality data. These assumptions are discussed in more detail in Buckland et al. (2015) (and previous editions).

Some survey designs have inbuilt protocols to minimise the impacts or bias caused by these assumptions, some of which are discussed below.

4.2.1. All animals on the transect line are detected

The Distance methods assume that all animals that occur on or very close to the transect line are detected with confidence and accuracy. For an accurate estimate, or an estimate as close to reality as possible, the density of animals on the transect line is assumed to represent the whole study area. If animals occurring on or close to the line are missed, the analysis will underestimate the abundance/density of animals in the area.

Good field survey protocols such as having multiple observers, applying specialised protocols such as double platform methods (see below) will minimise the chances of missing animals on or close to the transect line, as well as enabling estimation of the detection probability on the transect line in the cases where this is not zero. Therefore, improving the accuracy of the detection function.

4.2.2. The animals of interest do not move

For cetaceans this assumption is obviously not the reality as cetacean species are highly mobile. But Distance methods consider the data as a snapshot in time, conceptually freezing the animals in their location during the survey. However, representative or normal movement of the species during the survey time is unlikely to cause an issue or impact the accuracy of the estimated abundance.

But non-representative movement will cause inaccuracies, such as an animal traveling at a faster speed along the transect than the observers causing it to be double-counted, or animals actively moving towards or away from the observers. For cetacean line transect survey methods on boats or ships, it’s important to record the angle and distance while the animal is as far from the platform as possible before they actively move away or towards the vessel.

4.2.3. Measurements are accurate

Accurate measurements of distance is a key element of Distance sampling. On vessel based line transect surveys the distance from the line is calculated by measuring the distance of the animal from the observer and the angle of that sighting, both measurements need to be accurate.

When recording groups of animals, the distance should be measured from the centre of the group, though this can be difficult. A pragmatic method to achieve this is to measure the angle to the left edge of the group and the angle to the right of the group and use the mean of these two measurements.

Training of observers and provision of technologies (such as rangefinders and angle boards) to measure distance and angle of animals are part of good survey design and field protocols.

5. Data Collection Methods

Data standards can be met through the development of a robust data collection protocol that sets out the data collection methodology to be used. There are many existing data collection programmes for cetacean distribution and abundance data which all have established protocols to follow, but with differing standards and stipulations as to how to collect, store and/or submit data to relevant organisations and repositories.

JCDP compliant cetacean survey methods record;

- Identifier and environmental data (information relating to the survey platform whether this is a vessel, plane or UAV, and the environmental conditions such as sea state, visibility and weather conditions
- Effort data (information relating to when the observer(s) is/are actively searching for animals)
- Sighting data (information about the species, number of animals, direction and distance of the sighting, behaviour observed)

In the northeast Atlantic, a range of methodologies have been employed to collect monitoring data that are amenable to investigating abundance, distribution and temporal/spatial changes in these parameters.

Cetacean data generated through offshore industry surveys will encompass several different survey methods and take a variety of formats. Some likely are single-platform line transect surveys for cetaceans, whilst others may be dual-purpose that employ a protocol for seabird and cetacean data collection simultaneously. Data from offshore windfarm surveys are currently submitted to The Crown Estate (TCE) but not, necessarily, accompanied with the protocol used to collect the data. Data are submitted via an online portal, which ensures that they meet TCE's structural and metadata requirements, which are MEDIN-compliant.

5.1. Double-platform line transect shipboard surveys

The protocol used for the Small Cetaceans in European Atlantic waters and the North Sea (SCANS) surveys exemplify this methodology (Hammond *et al.*, 2002, 2013, 2021). SCANS shipboard surveys are double-platform (primary and tracker) observer surveys. Two teams of experienced observers search a 180° arc ahead of the vessel with naked eye (primary platform) or binoculars (tracker platform). Distance sampling data are recorded, and duplicate detections are identified in the field by the "duplicate identifier"; duplicate sightings are used to correct for animals missed on the transect line. The protocol is designed to result in robust data suitable for estimating absolute abundance. Typically, it is undertaken aboard large vessels although it is also carried out on some smaller vessels which are suited to the methodology.

5.2. Single-platform line transect shipboard surveys

This methodology is commonly used by surveyors on small boats that cannot accommodate a double-platform setup, and by volunteer survey networks operating from vessels of opportunity.

For example, the European Cetacean Monitoring Coalition (ECMC) is a collaborative of NGOs with similar survey methodologies, which have come together to collate data for use as a combined dataset in favour of high-quality research and evidence. The majority of these surveys are conducted from platforms of opportunity such as ferries. Surveys are single-platform effort-related and 1-2 observers search ahead of the vessel in a 90/180-degree arc.

Distance sampling data (radial distance and bearing) to each observation encountered are generally recorded and scanning is done with the naked eye and binoculars by each observer. Observers are trained in methods and cetacean identification by the respective organisation, predominantly in a classroom, and then placed with experienced surveyors for development. The data structure, coding and storage is in line with ECMC standards as defined by the project. The data collected are primarily suitable for analyses of relative density rather than absolute because they cannot be corrected for animals missed on the transect line.

The sampling methods are outlined in Brereton *et al*. (2009). Common variables recorded by the ECMC partnership can be summarised as;

- Sighting
    - Species identified with level of certainty or the lowest level of taxonomic certainty
    - Distance and bearing of the sighting
    - Group size and category of the count (best estimate, maximum or minimum)
    - Behaviour (based on a list of categories)
- Effort
    - Ship position
    - Direction of travel
    - Speed of travel
    - Sea state and environmental conditions

The use of commercial ferries as platforms for line transect cetacean surveys provide differences to dedicated research platforms. The high observation platform (15-37m) and the stability the ferry offers enables more accurate estimates of distance and bearing, but the faster travel speed (15 to 33 knots) offers less time for the observers to locate the animals and there is no option to leave the transect line to confirm species and group size (Brereton et al. 2009).

5.3. Modified strip transect

The early development of the European Seabirds at Sea (ESAS) methodology (Tasker et al. 1984) was based on a strip transect approach. Strip transects involve observers surveying and making detections within a fixed width “strip” and the assumption is that all objects (e.g. birds) are detected within that strip. However, where detection of the objects decreases with distance from the survey platform, a line transect method is preferable. The ESAS methodology was thus developed to account for imperfect detection.

For ESAS surveys, the strip is typically 300m wide (one side of the “line”) and was latterly subdivided with distance bands within it. Recording of detections by distance bands enables detection functions to be fitted. However, focus is within the 300-metre strip but detections from beyond this are recorded but without additional distance information. Data collected on ESAS surveys are primarily on seabirds but include observations of cetaceans (and other mammals, fish, etc). Data are collected from a 90-degree arc (i.e. one side of the survey platform), with detections restricted to those made with the naked eye.

5.4. Circle-back (or “race-track”) aerial surveys

This distance sampling method was used during the SCANS aerial surveys (Hammond et al 2013 & 2017) and is used so that absolute abundance estimates can be generated having been corrected for animals missed on the transect line. In this approach, on detecting a

group of animals, the aircraft circles back to resurvey a defined segment of the transect (Hiby, 1999); the full protocol is available in Gilles, Scheidat and Siebert (2009).

5.5. Digital aerial surveys

The use of digital video and still cameras instead of observers on aerial surveys has steadily increased over the last decade. The resolution of the camera systems varies, and the sampling is determined to some extent by the objective of the survey. Companies that operate these surveys have survey protocols in place.

Images collected during aerial surveys can be analysed using different approaches, such as using a transect or grid approach. For instance, data may be collected along a transect but the images are then analysed in a grid.

6. Cetacean survey design

Good survey design and field methods are key for obtaining accurate calculations of density and abundance, it is almost impossible to compensate for poor survey design at the analysis stage. There are resources and training available on the design and field methods for robust cetacean survey, and it is recommended to design any cetacean survey with these in mind.

6.1. Designing a survey

Designing the survey itself is an important step to a successful outcome. The planned transect lines should consider and mitigate the assumptions of distance sampling methods; such as being randomly located while being orientated perpendicular to the assumed population density and have good coverage of the survey area while also ensuring efficiency. The distance sampling R package (Miller, 2021) offers scripts to assist with transect design within a given survey area.

6.2. Field protocols

Ensuring good observer protocols and training leads to better quality data and outputs. Providing good quality training to all observers and ensuring observers follow field survey protocol throughout the survey effort are essential. Key aspects to good field protocols are outlined below, this list is not exhaustive.

6.2.1. Emphasise searching on and near the transect line

To meet the assumption that all animals encountered on the transect line are recorded, it is important to ensure that searching effort is emphasised on and near the transect line. This can be accomplished by ensuring the transect line is searched by multiple observers; for instance port and starboard observers both search along the transect line as part of the area they are covering.

6.2.2. Use of multiple observers

Using double-platform methods, discussed above, minimises the risks associated with missing animals as well as taking observer error into account during the analysis. Thus, leading to more true abundance and density estimates.

6.2.3. Use of binoculars to extend search area

As discussed above, distance sampling assumes there is no movement of the animal in relation to the observers as a result of the survey activity. By extending the search distance by using binoculars, the likelihood of sighting and recording an animal before its behaviour is influenced by the survey activity is increased. It is important that the equipment used during a survey is consistent, i.e. the observers use the same specification optics.

Vessel surveys traditionally use binoculars between 7 x and 8 x magnification, with high-powered options such as 25 x magnification used for tracker observers for double platform survey methods.

6.2.4. Training to improve distance and angle measurements using technology

Any inaccuracies with distance or angle of sighting measurements will influence the detection function, thus will bias the resulting density and abundance estimates from the survey. The use of angle boards to measure angle, and reticle binoculars, rangefinders or distance sticks to measure the distance of the sighting can improve accuracy.

An angle board is a board displaying protractor with a movable dial which can be moved to align to the direction of the sightings, the angle board is attached to the vessel immediately in front of each observer.

Reticle binoculars display a scaled axis within the eyepiece which can be used to measure distance from the horizon line and therefore estimate distance more accurately.

Rangefinders are laser devices which can accurately measure distance to an object, these devices can be expensive but can be helpful when training observers and calibrating survey transect width of the survey design.

A distance stick is a simple device, made from a ruler or stick, which displays the distance ranges from the horizon line to the observer. A distance stick is made specifically for each observer on each vessel by measuring the height of the observer eye above sea level and the distance of the observer eye to the distance stick when held in an out-stretched hand. The distance increments between the observer to the horizon line can be calculated and written on the stick and referred to estimate distance during a survey.

6.2.5. Running a pilot survey for training and testing of field methods

It is recommended that a pilot survey is run prior to a survey campaign to provide training to the observers and test the survey design and field protocols. This will allow refinement of the method before the survey itself without the loss of survey effort/data and associated costs or consequences which may occur. If not practical, then training of observers to ensure consistency in approach to recording is essential.

6.2.6. Recording clusters/pods

Some cetacean species are likely to be encountered in groups or pods, and this is incorporated into the distance sampling analysis to get both density of individuals as well as density of groups. To ensure accuracy of these estimates, the centre of the group should be used for distance and angle, with the maximum, minimum and best estimate for the number of individuals within the group being captured.

6.2.7. Ensure to record different data collection 'modes'

When a species has been encountered during a survey, there may be a need to leave the designated transect line to approach the individual or pod for example to confirm the species, get a better estimate of group size or collect additional data such as photographs for mark re-capture (photo identification). It is important to record this activity as separate from normal survey effort in the data. Some differentiate this activity as 'closing mode' (recording the time and location of where the closing mode started and ended), the data collected during this time would be excluded from the analysis for normal effort.

Once the closing mode activates has finished, the vessel should return to the transect line where it deviated and continue data collection as before.

6.3. Recording data

Traditionally survey data is recorded on paper forms specifically designed to meet the purposes of the survey and capturing all the mandatory, as well as some ancillary data generated during the survey effort. However, there are now technologies which can help to streamline data collection processes. These include GPS trackers, vessel loggers or specially designed software (such as Logger) which record the transect line and effort waypoints, and mobile or tablet apps to record sightings data which can be synchronised to the effort data post-collection.

Many dedicated mobile apps have been developed which record both effort and sightings from vessel based platforms. These apps automate as much information as possible from the devise itself, including GPS (for effort track and sighting locations), clock (for date and time), compass (for determining sighting bearings), etc. The data is saved to the devise to be downloaded later, and some apps also offering the ability to upload survey data directly to the associated organisation.

7. Sharing survey data with the JCDP

Once a survey has been completed and the data has been processed, it is encouraged that data is shared with the Joint Cetacean Data Programme to add value and continued use of these data.

The JCDP Data Standard outlines the format cetacean survey data needs to follow to be submitted to the JCDP Data Platform. The Data Standard can be found on the JCDP Resources page on the JCDP Hub: https://jncc.gov.uk/our-work/jcdp-resources, along with the JCD data template as well as guidance on JCDP metadata and a data use.

The JCDP Data Portal (https://cetaceans.ices.dk/) is hosted on the ICES Data Centre and provides online access to the JCDP database and facilities to submit and explore cetacean survey data.

For advice and further information about the Joint Cetacean Data Programme please contact marinemammals@jncc.gov.uk

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