

# Standard Operating Procedure

## SC22-28 VESSEL-BASED CETACEAN SURVEYS USING PHOTO IDENTIFICATION

Animal welfare is the responsibility of all personnel involved in the care and use of animals for scientific purposes.

Personnel involved in an Animal Ethics Committee approved project should read and understand their obligations under the *Australian code for the care and use of animals for scientific purposes*.

Version 1.0

August 2022



Department of **Biodiversity,  
Conservation and Attractions**

Department of Biodiversity, Conservation and Attractions  
Locked Bag 104  
Bentley Delivery Centre WA 6983  
Phone: (08) 9219 9000  
Fax: (08) 9334 0498

[www.dbca.wa.gov.au](http://www.dbca.wa.gov.au)

© Department of Biodiversity, Conservation and Attractions on behalf of the State of Western Australia 2022  
August 2022

This work is copyright. You may download, display, print and reproduce this material in unaltered form (retaining this notice) for your personal, non-commercial use or use within your organisation. Apart from any use as permitted under the *Copyright Act 1968*, all other rights are reserved. Requests and enquiries concerning reproduction and rights should be addressed to the Department of Biodiversity, Conservation and Attractions.

This document was prepared by Species and Communities Program, Biodiversity and Conservation Science, Department of Biodiversity, Conservation and Attractions.

Questions regarding the use of this material should be directed to:  
Species and Communities Program  
Department of Biodiversity, Conservation and Attractions  
Locked Bag 104  
Bentley Delivery Centre WA 6983  
Email: [animaethics@dbca.wa.gov.au](mailto:animaethics@dbca.wa.gov.au)

The recommended reference for this publication is:

Department of Biodiversity, Conservation and Attractions (2022). *Standard Operating Procedure SC22-28 Vessel-based Cetacean Surveys Using Photo Identification*, Department of Biodiversity, Conservation and Attractions, Western Australia.

### **Disclaimer**

The State of Western Australia and its employees do not guarantee that this publication is without flaw of any kind or is wholly appropriate for your particular purposes and therefore disclaims all liability for any error, loss or other consequence that may arise from you relying on any information in this publication.

This document is available in alternative formats on request.

Please note, URLs in this document which conclude a sentence are followed by a full point. If copying the URL, please do not include the full point.

**Revision History**

Version	Date	Details	Author/Reviewer	Approved By	Approval
1.0	24/03/2022	Document created	Dr Holly Raudino, Ellen D’Cruz & Dr Kelly Waples		
1.0	31/05/2022	Minor revision	L. Povh	M. Dziminski	August 2022

**Approvals: Version 1.0**

Approved by the DBCA Animal Ethics Committee:

**Dr Martin Dziminski**  
Chair, Animal Ethics Committee  
Department of Biodiversity, Conservation and Attractions

# Contents

1	Acknowledgement.....	4
2	Purpose .....	5
3	Scope.....	5
4	Animal Welfare Considerations.....	6
4.1	Level of Impact .....	6
	Environmental.....	6
	Social.....	6
5	Procedure Outline .....	7
5.1	Study area familiarisation .....	7
5.2	Equipment, care and maintenance.....	7
5.3	Personnel.....	8
5.4	Safety procedures.....	9
5.5	Survey protocol .....	9
5.5.1	Survey design .....	9
5.5.2	Undertaking the survey .....	10
5.6	Taking photos of cetaceans .....	14
5.7	Vessels and vessel handling.....	15
5.8	Data recording .....	16
5.9	Data processing .....	17
6	Competencies and Approvals.....	18
7	Occupational Health and Safety .....	18
7.1	Personal Protective Equipment .....	19
7.2	Manual handling and working with ropes .....	19
7.3	Working around the water’s edge and from vessels .....	19
8	Further Reading.....	19
9	References.....	19
10	Glossary of Terms.....	20
	Appendix I: Example of dolphin sighting datasheet. One sheet is used per group sighting. Please use this or contact authors for original. ....	21
	Appendix 2: Example of vessel survey datasheet. One sheet used per day to note breaks throughout the day and changes in weather, used to calculate overall survey effort. Please use this or contact authors for original. ....	22

Appendix 3: The table shows the possible combinations for the shorthand codes of different age and sex classes of cetaceans using the 1XX system. If more than one individual is encountered the numbering is consecutive 2XX, 3XX and so on, with the XX replaced by the appropriate letters for age and sex class if known or unknown, as below.....23

# 1 Acknowledgement

Advice for compiling the content of this standard operating procedure has been generously provided over the years from Deb Thiele, Alex Brown, and Daniel Barrow. We would like to acknowledge the traditional owner's past, present and emerging of the land and sea country we work on, Dambimangari, Murujuga, Yawuru, and it is an honour to work with these groups on their sea country. Thanks to DBCA staff and vessel crew throughout the Kimberley and Pilbara regions that have contributed to successful and safe surveys over the years.

## 2 Purpose

Cetaceans are recognised as key ecological assets in many marine parks across Western Australia, with targets to maintain their abundance, density and diversity within these areas. Cetaceans are of conservation significance, with a number of species listed as threatened under WA legislation (*Biodiversity Conservation Act 2016*), as well as nationally on the Environment Protection and Biodiversity Conservation Act 1999 and internationally on the IUCN Red List. These species also have high social and cultural value and are important to local communities and aboriginal groups in many areas. As such, Department of Biodiversity, Conservation and Attractions (DBCA) staff may be required to estimate metrics of abundance, density, distribution and diversity of cetacean species at key locations, as indicators of population health (i.e., numbers are stable, declining or increasing) and biologically important areas to inform management.

The standard technique used to assess cetacean abundance and distribution involves vessel survey and photo-identification of individual animals which allows for a mark recapture approach to abundance estimation and the compilation of sighting histories of individuals to evaluate population demographics. This Standard Operating Procedure (SOP) will cover the operational components of surveys conducted in the field including:

- Survey design and conduct.
- Operation of the vessel.
- Data collection and processing.

This SOP provides advice on the safe vessel operations and survey protocols required to carry out effective cetacean abundance, distribution and diversity surveys.

Much of this information is derived from protocols that are commonly used for this type of research around the world and on the experience of research scientists in the Marine Science Program.

## 3 Scope

This SOP has been written specifically for scientific purposes and endorsed by the department's Animal Ethics Committee. However, this SOP may also be appropriate for other situations.

This SOP applies to all vessel-based cetacean surveys undertaken across the State by Department of Biodiversity, Conservation and Attractions (hereafter department) personnel. It may also be used to guide fauna monitoring activities undertaken by Natural Resource Management groups, consultants, researchers and any other individuals or organisations. All department personnel involved in vessel-based cetacean surveys should be familiar with the content of this document.

Projects involving wildlife may require a licence under the provisions of the *Biodiversity Conservation Act 2016*. Personnel should consult the department's Wildlife Licensing Section and Animal Ethics Committee Executive Officer for further guidance. In Western Australia, any person using animals for scientific purposes must also be covered by a licence issued

under the provisions of the *Animal Welfare Act 2002*, which is administered by the Department of Primary Industries and Regional Development. This SOP complements the *Australian code of practice for the care and use of animals for scientific purposes* (The Code). The Code provides governing principles to guide decisions and actions of personnel involved in the care and use of animals and contains an introduction to the ethical use of animals in wildlife studies. A copy of The Code may be viewed by visiting the National Health and Medical Research Council website (<http://www.nhmrc.gov.au>).

## 4 Animal Welfare Considerations

To reduce the level of impact on the welfare of animals, staff must consider, address and plan for the range of welfare impacts that may be encountered. Strategies to reduce impacts should be identified during the planning stage to ensure that they can be readily implemented during activities and contingencies for managing welfare issues have been identified. All personnel involved in the project should be aware of the range of issues that they may encounter, the options that are available for reducing impacts and improving animal welfare, and the process for managing adverse events.

Department projects involving cetacean surveys will require approval from the department's Animal Ethics Committee.

### 4.1 Level of Impact

#### **Environmental**

Exposure to vessels and the associated motor noise can disturb cetaceans and disrupt critical activities such as feeding, resting and nursing and attending to calves. Vessels should be handled in a way that minimises disturbance to the targeted fauna. Time limits for encounters with individual cetacean groups should be set and complied with. As a guide 60 minutes should be the maximum time that a cetacean group is followed at a distance <100 metres. If all dolphin group members have not been photographed the encounter should be ended anyway after this period. Approach distances are prescribed under the *Biodiversity Conservation Regulations 2018* and further licence conditions with time limits may be added to scientific licences. Injured, entangled or compromised individuals should not be approached closer than the prescribed approach distances. Further consideration should be given to young e.g., newborn calves or animals in critical areas or at critical times i.e., calving and nursing. The duration of encounters should be further limited if groups contain newborns or groups are resting or nursing young calves to prevent disruption of critical activities.

#### **Social**

There may be live-aboard vessels or other commercial operations occurring within the survey area. It is recommended that effort is made to contact or approach these vessels prior to conducting the survey to explain the operation, and if required determine how to work around any commercial operations such as barramundi netting, crabbing, pearling, tourism interactions etc. If commercial or recreational vessels enter the survey area during a survey, they should be contacted via radio to communicate the on-going operations and told not to



approach animal groups closer than 100metres while DBCA vessels are photographing and observing them. If a research vessel is already with an animal group other research teams should find alternative groups to survey to minimise the cumulative exposure of vessels.

## 5 Procedure Outline

### 5.1 Study area familiarisation

Many of the areas (bays, rivers, coastal waters and open ocean) where these surveys will be conducted contain navigational hazards. These hazards can consist of, but are not limited to, submerged rocks, sand bars, tidal rips, tidal bores, whirlpools, commercial fishing nets, logs and other marine debris. Keep in mind that cetacean surveys may occur over multiple days, traversing different locations each day depending on sample design and prevailing weather conditions. It is critical that the vessel master is familiar with the survey area and potential hazards and that all crew / observers keep a good look out.

Steps to help assess survey area:

1. Study charts and tide tables if available.
2. Read reports from surveys conducted previously in the area.
3. Seek information from locals and other staff that have worked in the area.

### 5.2 Equipment, care and maintenance

All equipment (incl. spares) should be tested and in good working order prior to departure for a survey (Figure 1). A check list should be created including all equipment and cleaning materials required (incl. spares) for the duration of the survey (Table 1). After returning from the day's survey, all equipment should be wiped down to remove salt spray, data downloaded and placed on charge. It is useful to have a charging and data download area for this purpose.



Figure 1 Equipment required for vessel-based cetacean surveys: (a) rechargeable batteries and charger, (b) handheld GPS (WGS84), (c) GPS cord, (d) DSLR camera manual, (e) DSLR camera with a 400mm zoom lens, (f) DSLR camera batteries, (g) DSLR battery charger, (h) 2Tb external hard drives, (i) pencils, (j) SD card reader, (k) clipboard and datasheets, (l) printed and laminated copies of Scientific and AEC licences, (m) binoculars, (n) Pelican waterproof protective case.

Table 1 List of survey equipment typically required for a vessel-based cetacean survey running over multiple days. Note: AMSA regulations must be followed for safety equipment required onboard survey vessels.

Item	Quantity
Rechargeable Batteries (AA, AAA) + charger	12 each
Binoculars	2
DSLR camera with a 400mm zoom lens	1 & 1 spare if possible
Spare DSLR camera batteries + charger	At least two
DSLR camera manual	1
First aid kit	1
Food and water	Lunch, 2 snacks each and 20L of water **
Fuel	Enough to complete survey and 15% reserve **
Handheld GPS (WGS84) + downloading cords	1 & 1 spare
External hard drive	At least 2
On-board navigation system (ideal)	1
Paper data sheets and pencils	20 sheets **
Propellers (Spare split pins & lock nuts)	3 aluminium
Protective clothes including sunglasses	Per person
Repair tool kit	1
Ropes	3
SD card reader	1 & 1 spare if possible
Sunscreen	1
Printed and laminated copies of Scientific and AEC licences	

\*\* Items need to be replenished each day of the survey when a multiple day survey is underway.

### 5.3 Personnel

There are three essential personnel required for vessel-based cetacean surveys:

- The vessel master, responsible for safety and manoeuvring the survey vessel
- The photographer, responsible for photographing cetacean dorsal fins for cataloguing and recording data during cetacean sightings

- Additional observer, it is also recommended to have one (or more) observers on board to assist in searching and spotting cetaceans and recording data, including GPS positions, while the photographer is capturing images.

A second photographer is incredibly valuable if possible. While a minimum of three is required, ideally a field team would comprise 3-5 individuals with multiple skill sets that could undertake more than one of the necessary tasks.

## 5.4 Safety procedures

Surveys can be challenging due to the working environment and physical conditions. A survey can last all day (up to 12 hours) with suitable weather conditions, and personnel may be exposed to the elements for the duration. Appropriate protective clothing for the area of work and weather is essential. This should include adequate sun protection (i.e., long-sleeved clothing, long pants, sunscreen, hat, face buff, hand gloves, shoes) as well as protection from wind chill and other changes in weather (raincoat may be required). Polarised sunglasses are recommended as there is often glare when searching for animals on the water. Insect repellent may improve comfort and reduce risk of acquiring insect-borne disease if surveying in areas where there may be many insects e.g., mangroves. A break of 10 minutes every 90 minutes is good practice as it allows the team to retain concentration during a survey. Enough food and water should be taken out each day to last the whole day.

Be prepared for emergencies. A first aid kit, satellite phone (and alternative communication i.e., handheld or marine VHF radio), emergency flares, EPIRB, life jackets and repair tool kit must be present on all survey vessels. The vessel should also have oars, ropes, spare propeller, and sufficient fuel for the day. Oars are important for escaping from shallow water where the engine cannot be used.

Prior to conducting a survey, the following approved documents, along with this SOP, should be in place and have been read by all survey team members:

1. Field Trip Advice (standard for all operations).
2. Emergency Response Plan and/or Medical Evacuation Plan.
3. Communication plan between base and survey team.
4. A Job Safety Analysis (JSA) for all staff involved.
5. *Animal Welfare Act 2002* Licence to use animals for scientific purposes.

## 5.5 Survey protocol

### 5.5.1 Survey design

Sampling design must be decided upon and planned prior to going into the field. This will ensure that an appropriate vessel is chosen and that the field team is adequately prepared on a daily basis to complete the survey planned. Designing a survey is dependent upon the question that is being asked and the technique that is being used to collect data. Various techniques are used to estimate abundance and distribution and rely on adequate and equal

coverage of an area and the ability to consistently detect the species of interest. This can be done using a random or a systematic design. For example, systematic surveys can be undertaken using pre-determined transect lines (as in Raudino *et al.*, 2018a), not following pre-determined transects but travelling through an area in a specific direction, such as north to south (as in Raudino *et al.*, 2018b) or zig zagging to spread survey effort evenly across the area of interest. Additional data can be collected opportunistically while vessels are transiting (example in Raudino *et al.*, 2019a) or by concentrating in an area (as the commercial vessels did in Raudino *et al.*, 2019b).

For the purposes of this SOP, mark recapture is being used as the method to estimate abundance. This relies on repeated sightings of 'marked' or recognisable individuals. Thus, during a full survey using pre-determined transects, the transects should be repeated a minimum of three times over a relatively short time period (i.e., ideally three consecutive days, but less than one week [if possible]) to minimise the chance that cetaceans will be missed. This may occur because: 1) the cetaceans are at the water surface but missed by observers (perception bias) or 2) the cetaceans are submerged during a dive and not available to be detected (availability bias). Three repeats of transects covering the entire study area allow abundance estimates to be mathematically modelled taking these biases into account, which provides confidence intervals around the estimate calculated. An important underlying assumption is that there is equal chance of encountering the animals being surveyed and therefore if they are randomly distributed across the survey area then the entire area must be surveyed. The alternative is a direct count (census) which has lower accuracy and does not quantify individuals in the population that are missed. The aim of a census is to account for all individuals in the population that are present so even survey coverage of the area is less important. Nevertheless, it is important in both cases to repeat the transects to increase the chances of sighting those animals that may be submerged and missed or missed by fatigued observers.

Prior to going out into the field, the team leader will create the survey plan, including transects that are expected to be conducted over the course of the trip. These pre-determined transects will be entered into a GPS system to be used on board the survey vessels and followed during the survey. The actual survey tracks will be set to automatically download onto a handheld GPS. The actual day to day plan of survey activity may be weather dependent and will be decided by the team leader prior to each day's activity and relayed to the survey team.

### 5.5.2 Undertaking the survey

A survey targeting cetaceans can only be conducted in suitable sea conditions (Beaufort Sea State [BSS] Table 2). Suitable conditions will be defined based on the species of interest and their surfacing profile. For example, surveys for tropical dolphin species such as Australian snubfin (*Orcaella heinsohni*) and humpback dolphins (*Sousa sahulensis*) should only be conducted in BSS  $\leq 2$ . These dolphins have a low surfacing profile, so may be missed in conditions (BSS  $> 2$ ) where white caps are present, resulting in a misleading underestimate of the number of dolphins using an area. However, surveys targeting other species such as Indo-Pacific bottlenose dolphin (*Tursiops aduncus*), or humpback whales (*Megaptera novaeangliae*) may be conducted in BSS  $\leq 3$  due to the higher surfacing profile and other sighting cues such as taller blows for these species. Weather should be evaluated prior to the survey day, assessed at the beginning of the day and monitored regularly to determine when

sea conditions exceed the acceptable threshold for the species of interest. Consideration may be given to the transects to be followed for the day based on prevailing wind conditions. If weather conditions exceed the acceptable BSS rating, the survey should not be initiated, or if underway, should be terminated until the weather conditions improve.

Table 2 Beaufort Sea State scale description

Beaufort number	Wind speed (knots)	Wave height (m)	Sea conditions
0	< 1	0	Flat
1	1-3	0 - 0.2	Ripples without crests
2	4-6	0.2 – 0.5	Small wavelets. Crests of glassy appearance, not breaking.
3	7-10	0.5 – 1	Large wavelets. Crests begin to break; <b>scattered whitecaps</b> .
4	11-16	1 - 2	Small waves with breaking crests. Fairly <b>frequent whitecaps</b> .
5	17-21	2-3	Moderate waves of some length. <b>Many whitecaps</b> . Small amounts of spray.

The team leader will make the decision on the day's survey based on prevailing weather conditions and will advise the team of the survey departure time and the transects that will be covered. This information should be loaded into the GPS on board the survey vessel and the GPS should be set to automatically record the vessel's position periodically (recommended minimum one second, maximum 30 second intervals) so that the survey area covered can be mapped and visualised and the total distance on and off survey effort can later be calculated. The survey vessel should proceed to the beginning of the first transect to start the survey. Vessels should maintain a speed of <10 knots (ideally 5-8 knots) while surveying (i.e., on transect). However, when a sighting has been made and the vessel is approaching a group or individual, speed should be reduced to no wake or neutral particularly when close to groups (e.g., within 10-50m depending on the species). Note scientific licences from DBCA allow closer approaches than prescribed in the Biodiversity Conservation Regulations 2018 but researchers must follow their specific licence conditions and minimum distances should not be breached. Vessels can transit between transects at faster speeds (while remaining mindful of depth and potential for collisions with submerged obstacles or marine fauna). It is recommended that the survey team comprise a minimum of three people on board each survey vessel including the vessel master and two observers (at least one of which is experienced) dedicated to scanning for animals (with the naked eye) ahead and on each side of the vessel. The port side observer should concentrate from the bow to the port side midships, and the starboard observer should concentrate from the bow to the starboard side midships, while the vessel master mainly focuses ahead of the bow. The daily datasheet should be filled in throughout the transect as described below in section 4.8 *Data Recording*.

When cetaceans are sighted, a waypoint will be taken by either the vessel master using the on-board navigation system, or by an observer using the handheld GPS and the time recorded. The vessel will then leave the transect and approach the cetacean group to collect data. The observers will identify the species, estimated number of individuals and activity on approach. Once within close proximity to the cetacean group (10-50m) the sighting location (latitude

and longitude) will be recorded using the GPS. Additional information confirming group size, composition (i.e., species, sex and age class) and behavioural activity will also be recorded on the relevant data sheet along with environmental variables and survey team information (see data sheet, Appendix 1). During the sighting at least one person using a DSLR camera with a zoom lens (minimum 400mm) should be taking photographs, although having two photographers on board is better.

Photographs of the dorsal fins of all group members will be taken for the purpose of photo-identification of individual dolphins (Figure 2). For some large whale species, other features can be used for identification and should be photographed. This may include underside of flukes for humpback whales, the callosity pattern on the head for southern right whales, and the lateral pigmentation pattern for blue whales (Figure 2). Any unusual marking, injury, scarring or pigmentation for all species should also be photographed when observed. Personnel should attempt to photograph all individuals in each encounter before ending the sighting and resuming the survey at the point where the transect line was departed. A cetacean group is defined as members within 100m of each other and engaged in the same behavioural activity, as per Parra (2006). Additionally, photographs and videos of behavioural activity such as feeding or social behaviour can be incredibly informative and should be taken when possible (Figure 3). In particular, photographs/video of prey items can help understand what the species feed on.

Once all animals have been photographed adequately (see section 4.6) the team leader should confirm the information recorded on the data sheet is correct for the sighting and photograph the hardcopy data sheet. This photograph of the datasheet serves as a marker between sightings/ group encounters as well as a backup copy in the field. The datasheet should then be stored in a dry, safe location for the remainder of the trip. Once the sighting has been completed, the vessel should return to the waypoint where it left the transect and continue on transect.





Figure 2 Photographs taken during vessel-based cetacean surveys used in identifying species and individuals based on unique patterns of nicks, scarring and pigmentation: (a) Australian snubfin dolphin (*Orcaella heinsohni*) dorsal fin, (b) Australian humpback dolphin (*Sousa*

*sahulensis*) dorsal fin, (c) Indo-pacific bottlenose dolphin (*Tursiops aduncus*) dorsal fin, (d) Humpback whale (*Megaptera novaeangliae*) blow, (e) Humpback whale dorsal fin, (f) Humpback whale fluke, (g) Southern right whale (*Eubalaena australis*) callosity pattern on top of head, (h) Blue whale (*Balaenoptera musculus*) lateral side. Different body parts are used to identify individuals of different species i.e., the edge of dolphins' dorsal fins and overall dorsal fin shape, underside of tail flukes for humpback whales, the callosity pattern on the head for southern right whales and the pigmentation pattern along the lateral side for blue whales.

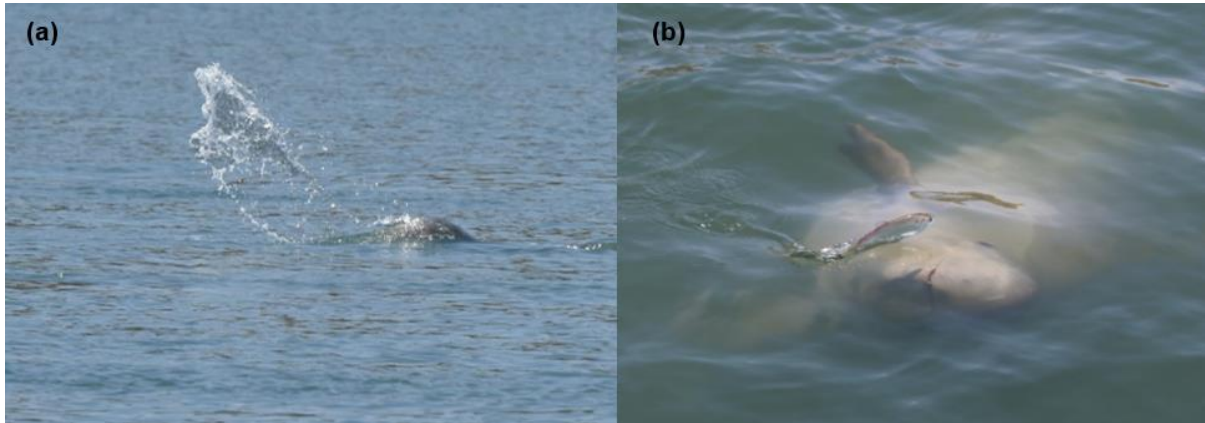


Figure 3 Photographs taken during vessel-based cetacean survey showing: a) unique feeding behaviour observed in Australian snubfin dolphins (*Orcaella heinsohni*) and b) photograph of a fish allowing species identification showing what the dolphins were feeding on.

## 5.6 Taking photos of cetaceans

The camera used for cetacean photography is a DSLR camera with a zoom lens (minimum 400mm) and should be set to the standard settings outlined below. These can be changed by referring to the camera manual:

- Mode: Sports (or similar for fast moving objects)
- Autofocus: On
- Burst pulse (multiple images per second): On

The following checklist should be completed each morning before starting the survey:

- Battery is fully charged
- Lens is clean
- Camera settings are as above
- Focal point is in the correct position (centre) or set to minimum number of focal points (depending on camera model)

When photographing:

- Ensure camera strap is around your neck



- Hold camera in one hand and support the lens with the other
- Depress the button halfway to focus
- Anticipate where the cetacean will surface and already be focused on that area
- Take photo when cetacean emerges from water, keep finger help down to capture surfacing sequence
- After the sighting, use the review panel to make sure the photos are focussed and to confirm adequate images of each individual

## 5.7 Vessels and vessel handling

A survey vessel needs to be large enough to accommodate the survey team (minimum of three people) and the survey gear. It will also need to comply with the Department of Parks and Wildlife Corporate Policy Statement No. 84 Boating.

Surveys can be done from a variety of vessels ranging in size (typically ranging between 5-25 metres). The vessel should be equipped with adequate fuel and carry all necessary safety equipment. The vessel master should have adequate experience and an appropriate qualification for the survey area (e.g., Coxswain certificate). Vessel masters should be familiar with techniques used in cetacean surveys as described above and be able to drive in a way that minimises disturbance to marine fauna (ideally paralleling the animal's direction of travel at a distance that does not impede their movement or cause them to avoid the vessel), while positioning the photographer in the optimal position for photo-identification (ideally with sun behind the photographer so that the cetacean being photographed is not back lit and silhouetted).

Vessels should maintain a speed of <10 knots (ideally 5-8 knots) while surveying (i.e., on transect). However, when a sighting has been made and the vessel is approaching a group or individual, speed should be reduced to no wake or neutral particularly when close to groups (e.g., within 50m). Vessels can transit between transects at faster speeds (while remaining mindful of depth and potential for collisions with submerged obstacles or marine fauna. If surveying pre-determined transects, these should be pre-loaded into the on-board navigation system for the vessel master to easily follow. Alternatively, the vessel master should be provided a handheld GPS or tablet device with the transects visible to follow.

Once a cetacean has been sighted:

1. Vessel speed should be gradually reduced to minimise any bow wave or sudden change in engine noise likely to increase the probability of the group fleeing or diving. Avoid turning the engine on and off during an encounter as this can confuse cetaceans as they try to determine the changing position of the vessel without the consistent motor sound. Do not use reverse or the electric tilt to trim the motor if avoidable as the sound of the engine changing gears and the hydraulic lift is amplified underwater which can also disturb cetaceans.
2. The point where the transect is left will be marked with a waypoint by the vessel master using the on-board navigation system or by one of the observers using a handheld GPS.
3. Steer the vessel towards where the observer last sighted the group, in the safest (clear of obstacles) direction possible at a speed of 2-5knots. The vessel master will need to look

for the animals, watch for hand signals from the observers and be aware of other environmental factors (water depth, currents, obstacles in the water).

4. Once observers have collected required information the survey can be resumed. If following a pre-determined survey design, return to the point where the transect line was departed and continue on transect.

## 5.8 Data recording

At the start of each survey day a Survey Datasheet needs to be filled out that records the survey start time, field team and starting environmental conditions (Appendix 2). One row should be scribed each time there is 1) a change in weather conditions, 2) a change in survey effort for a break or transit between transects, in which a row for stopping effort (Effort = Off) and a row indicating the survey resuming (Effort = On) should be recorded and 3) a sighting of an animal of interest that is not being actively searched for (e.g., dugong, manta ray, turtle etc.). GPS coordinates should be obtained from the handheld GPS and environmental data from the navigation system (depth, water temperature) and expert / local knowledge (BSS and wind direction and speed).

When a sighting is made, a new Sighting Datasheet is filled in (Appendix 1). Generally, the secondary observer is responsible for filling out the datasheets as the vessel master and photographer are focussed on the animals. Essential data to be recorded at the start of a sighting are start time, location (waypoint can be marked then written in full at end of sighting) and group size estimate including whether any calves are present. The observer records information called out by the photographer and fills out environmental variables, GPS position, information on the group membership and all other data fields listed in the Sighting Datasheet (Appendix 1). During a sighting, the time the encounter starts is recorded and notes made on predominant behavioural activity during first five minutes of the encounter (>2.5 minutes of the five minutes, expanded in Table 3). If you are unsure of the actual activity, make notes about what you see, the surfacing type and how close the group are spaced to one another. Confirm or discuss observations with the vessel master, photographer or other observers.

Sighting number is recorded at the top of each new sighting sheet. Sighting numbers are continuous for each day but restart at one the following day i.e., each first sighting of the day should be sighting one. GPS coordinates should be taken from the handheld GPS on board with coordinates in decimal degrees and waypoint number noted on the datasheet or, if time permits, the coordinates transcribed on the datasheet. Substrate and environmental data can be obtained from the on-board navigation system (depth, water temperature etc.) and expert / local knowledge (substrate, BSS and wind direction). When in doubt, ask other members of the survey team. If substrate is unknown, it can be left blank. Some data can be gathered post field such as tide height and state can be taken from tide tables for the area ([http://www.bom.gov.au/oceanography/projects/ntc/wa\\_tide\\_tables.shtml](http://www.bom.gov.au/oceanography/projects/ntc/wa_tide_tables.shtml)).

Information on the dolphins should be recorded in the section on possible IDs. This may include the identity of familiar dolphins already in the DolFin catalogue that have assigned ID codes/names. **Even recognisable dolphins should always be photographed regardless of familiarity to update the catalogue with any changes to the dorsal fin and for the sighting history.** Sex or age class (adult, juvenile, calf) of animals should also be noted if it can be

determined. The 1XX system can be useful for differentiating between unknown individuals in the field. Codes are 1 adult/calf/juvenile and male/female/unknown (i.e., 1AF is shorthand for 1 adult female, see Appendix 3 for more details and all sex/age class combinations). If age and sex are unknown a description of dorsal fin shape or marks can be useful. Notes on distinctive dorsal fins such as unique scarring, nicks, pigmentation or deformities can be drawn on the dorsal fin templates as well as notes made on the number of 'clean fins' (dorsal fins with no marks). If photos are captured of specific animals, note the camera frame numbers using the playback display panel on the camera. The photographer will dictate this above information, which should be recorded and confirmed at the end of the sighting. Ensure all data fields are filled in and photograph the hard copy sheets to indicate the end of the sighting.

The datasheets that are currently used for dolphin survey are attached in Appendices 1 and 2. A variation of these could be developed with a desktop computer or pencil and paper as needed, ensuring that the key information is recorded.

*Table 3 Surfacing types listed in dolphin sighting sheet expanded*

Datasheet code	Surfacing type
rg	Regular
td	Tail dive
pd	Peduncle dive
snag	Snagging
bow	Bow riding
rt	Rooster tail
pp	Porpoising
lp	Leap
BP (calf)	Calf in baby position, close proximity to adult mother between dorsal fin and tail, <0.3m

## 5.9 Data processing

At the end of the day, all photos from each camera used should be downloaded onto an external hard drive into the trip folder, in a new folder labelled with that day's date (YYYYMMDD). Do not clear SD cards as they will be used as backups until the photos are transferred on to the server. If operating multiple vessels, the folder should include the vessel name (e.g., YYYYMMDD\_vessel name). The GPS tracks should be loaded into a folder containing all the GPS data for the trip. If time permits these can be copied into an appropriate file format for uploading to the DolFin database (csv with the headings type, Ident, Lat, Long, Y\_Proj, X\_Proj, New\_Seg, Time, Speed, Effort\_On, Effort\_Off). The datasheets should be reviewed to ensure all information has been recorded on the appropriate datasheets and then kept in a safe location on the mother vessel or accommodation. Once all data is copied onto the external hard drive, make a backup on the second external hard drive. The photos

can be filed by sighting, graded and cropped for fin identification if observers have experience in that process, however if unsure of the process, then leave for the data custodian.

## 6 Competencies and Approvals

*A person who is competent has the knowledge, skills, and experiences that allow them to undertake vessel-based cetacean surveys and appropriately manage adverse events as required. Department personnel, and other external parties covered by the department's Animal Ethics Committee, undertaking projects involving cetacean surveys require approval from the committee and will need to satisfy the competency requirements (Table 4). Other groups, organisations or individuals using this SOP to guide their activities are encouraged to also meet these competency requirements as well as their animal welfare legislative obligations.*

Table 4 Competencies for personnel involved in vessel-based cetacean surveys

Competency Category	Competency Requirement	Competency Assessment
<b>Photographer / Observer</b>	Prior experience – competency requirement.	Trainees observe and assist under the direction of experienced supervisor as a photographer before completing a survey independently.
<b>Vessel master</b>	Minimum of Coxswain 2 Near Coastal certificate.	AMSA approved assessment. Note there may be limitations to the area of operation.
<b>Observer / Data recorder</b>	Prior training, experience ideal – competency requirement.	Trainees observe and assist under the direction of experienced supervisors in the data recording role.

## 7 Occupational Health and Safety

A first aid kit, satellite phone and VHF radio should be carried in the vessel at all times. While all team members should be aware of their own safety and the safety of others, at least one team member must have senior first aid training.

A job safety analysis is necessary prior to undertaking cetacean surveys.

Extreme care should be taken when working in tidal estuaries to avoid exposure to disease carrying insects, like mosquitos and sand-flies. All injuries (even superficial ones) and bites should be appropriately treated as soon as possible to prevent infection and promote healing.

Departmental personnel, contractors and volunteers have duties and responsibilities under the Occupational Safety and Health Act 1984 and Occupational Safety and Health Regulations 1996 to ensure the health and safety of all involved. Fieldwork is to be undertaken in line with the department's corporate guidelines, policies and standard operating procedures, including but not limited to, risk management and job safety analyses. Further information can be found at

<https://dpaw.sharepoint.com/Divisions/corporate/people-services/HS/SitePages/SOPs.aspx>

If department personnel or volunteers are injured, please refer to the departmental Health, Safety and Wellbeing Section's 'Reporting Hazards, Near-misses and Incidents' intranet page, which can be found at <https://dpaw.sharepoint.com/Divisions/corporate/people-services/HS/SitePages/Reporting-Hazards,-Near-Misses-and-Incidents.aspx>

## 7.1 Personal Protective Equipment

Protective gear required shall be determined by the project specific JSA. This may include but is not limited to adequate sun protection (i.e., long-sleeved clothing, sunscreen, hat, face buff, hand gloves, boat shoes, polarised sunglasses), protection from wind chill and other changes in weather (raincoat may be required).

## 7.2 Manual handling and working with ropes

Manual handling and working with ropes can be an integral part of working with small vessels with detachable outboards and there is a high risk of injury (muscular or back). Training is mandatory for DBCA personnel and available through the Health, Safety and Wellbeing induction.

## 7.3 Working around the water's edge and from vessels

PDF type 1 Life jackets must be worn by those working on vessels. Refer to Department of Parks and Wildlife Corporate Policy Statement No. 84 Boating.

Care must be exercised to avoid slipping into the water from the vessel or when working on riverbanks and boat ramps. All limbs must be kept within the vessel at all times.

# 8 Further Reading

The following documents have been mentioned in the advice regarding vessel-based cetacean surveys. It is recommended these documents and others listed below are also considered when proposing to undertake vessel-based cetacean surveys.

- Department of Parks and Wildlife Corporate Policy Statement No. 84 Boating
- Department of Parks and Wildlife Boating Code of Practice 2016
- *Occupational Safety and Health Act 1984*
- *Occupational Safety and Health Regulations 1996*
- *Biodiversity Conservation Act 2016*
- *Biodiversity Conservation Regulations 2018*

# 9 References

Brown, A.M., Bejder, L, Pollock K.H., Allen, S.J. (2016) Site-Specific Assessments of the Abundance of Three Inshore Dolphin Species to Inform Conservation and Management

Frontiers in Marine Science 3, DOI=10.3389/fmars.2016.00004

Parra, G.J., (2006). Resource partitioning in sympatric delphinids: space use and habitat preferences of Australian snubfin and Indo-Pacific humpback dolphins. *Journal of Animal Ecology* 75: 862-874.

Raudino, H.C., Douglas, C.R., Waples, K.A. (2018). How many dolphins live near a coastal development? *Regional Studies in Marine Science* 19: 25-32  
<https://doi.org/10.1016/j.rsma.2018.03.004>

Raudino, H.C., Hunt, T.N., Waples, K.A. (2018). Records of Australian humpback dolphins (*Sousa sahalensis*) from an offshore island group in Western Australia. *Marine Biodiversity Records* 11, 14 <https://doi.org/10.1186/s41200-018-0147-0>

Raudino, H.C., D’Cruz, E.C., Barrow, D., Waples, K.A. (2019). Dambimangari Rangers Joint Management tropical inshore dolphin survey in Lalang-garram/Camden Sound Marine Park, 23 -30 Sept 2019. Department of Biodiversity, Conservation and Attractions, Perth, Western Australia.

Raudino, H.C., Douglas, C.R., D’Cruz, E.C., Waples, K.A. (2019). Snubfin dolphin census in Yawuru Nagulagan/Roebuck Bay. Department of Biodiversity, Conservation and Attractions, Perth, Western Australia.

Smith, H.C., Pollock, K., Waples, K., Bradley, S., Bejder, L., 2013. Use of the robust design to estimate seasonal abundance and demographic parameters of a coastal bottlenose dolphin (*Tursiops aduncus*) population. *PLoS ONE* 8, e76574.

Thiele, D. 2010. Collision course: snubfin dolphin injuries in Roebuck Bay. Report to WWF-Australia.

Wildlife Conservation (Specially Protected Fauna) Notice 2018, ([https://www.dpaw.wa.gov.au/images/documents/plants-animals/threatened-species/Listings/fauna\\_notice.pdf](https://www.dpaw.wa.gov.au/images/documents/plants-animals/threatened-species/Listings/fauna_notice.pdf))

## 10 Glossary of Terms

**Cetacean:** Marine mammals commonly known as whales, dolphins and porpoises.

**Dorsal fin:** the fin located on the top side of an animal, commonly used to identify species.

**Beaufort Sea State (BSS):** scale for estimating wind strengths based on appearance of the sea surface. Often used by researchers as it affects the probability of sighting cetaceans.

**DolFin:** State-wide database of dolphin sightings data with associated photographs and survey information.

**Appendix I:** Example of dolphin sighting datasheet. One sheet is used per group sighting. Please use this or contact authors for original.

2007/v. hs															
Date: ____/____/____	GPS GARMIN		Substrate (circle one)			Entered DB									
Photographer:	Datum	WGS84	seagrass	Depth (m)	_____										
Scribe:	Transect	South 21	algae	Beaufort (0-5)	_____										
			sand	Wind Dir/spd	_____										
Sighting #			reef	Water temp	_____										
Time Sighting Start:			mud/silt	Salinity	_____										
Time Sighting End:	East 115		not visible	Turbidity	_____										
Resight (no new IDs)?	DECIMAL DEGREES FORMAT			Tide	_____										
				Tide State	_____										
				Swell	_____										
Use 1XX as identifier for cleanfins and unknowns and describe distinguishing features MIXED SPECIES SIGHTING Y															
Place animals that arrive > 5 min in square [brackets]															
ID codes or names;		SNUBFIN		HUMPBACK		BOTTLENOSE									
Possible ID's followed by question mark (?)		#Ds 1st 5min	Est/Act	#Ds 1st 5min	Est/Act	#Ds 1st 5min	Est/Act								
ADULTS			E		E		E								
			A		A		A								
JUVIES			E		E		E								
			A		A		A								
CALVES			E		E		E								
			A		A		A								
		Total # Ds before depart		Total # Ds before depart		Total # Ds before depart									
ADULTS			E		E		E								
			A		A		A								
JUVIES			E		E		E								
			A		A		A								
CALVES			E		E		E								
			A		A		A								
Arrivals (IDs and times):															
Departures (IDs and times):															
GROUP DATA during first 5 min: Circle from list. Put later data in notes															
Predomin Activity	Cohesiveness metres	Surfacing	Spd.knts	BP (est)	anytime in survey										
Rest	Vtig <3	rg	Slow <2		: y / n										
Travel	Tig > 3-2	td	Cruise 2-4		: y / n										
Socialize	Md 2-10	pd	Mod 4-6		: y / n										
Forage	Spr 10-25	snag	Fast >6		: y / n										
Feeding	Wsp > 25	bow			: y / n										
Unknown (1st 5 min)		rt			: y / n										
		pp			: y / n										
		lp			: y / n										
<p>NOTES</p> <p>sex and scarring of specific individuals</p> <p>describe fish seen and photograph if possible</p>															
								Photo-ID: compact/SD card # and frame #'s, and blank frame #'s						All ID? Y N U	
								D800						All fins photographed?	
								D7100						Y N U	

**Appendix 2:** Example of vessel survey datasheet. One sheet used per day to note breaks throughout the day and changes in weather, used to calculate overall survey effort. Please use this or contact authors for original.

Date	Skipper	Scribe	Photographer	Vessel	Transect Route						
Engine Hours Before Purchase		Engine Hours After Fuel Cost		Distance Travelled							
Fuel Purchase		Fuel Cost		Fuel Used							
#	Time 24 hr format	GPS South -21°	GPS East 115°	WPT Name or #	Reason Sighting / Break	Transect Effort On / Off	Beaufort 0-5	Wind Speed	Wind Direction	Depth	Water Temperature
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											



**Appendix 3:** The table shows the possible combinations for the shorthand codes of different age and sex classes of cetaceans using the 1XX system. If more than one individual is encountered the numbering is consecutive 2XX, 3XX and so on, with the XX replaced by the appropriate letters for age and sex class if known or unknown, as below.

Sex/Age Class	Adult (A)	Juvenile (J)	Calf (C)
Male (M)	1AM	1JM	1CM
Female (F)	1AF	1FJ	1CF
Unknown (U)	1AU	1JU	1CU