Australian Government
Department of Sustainability, Environment, Water, Population and Communities
Australian Antarctic Division

Antarctic Blue Whale Voyage 2013: Science Plan

File [TRIM] ref: Container: Record No:	Authorising Officer: Mike Double Senior Marine Mammal Research Scientist	Authorisation Date: March 2013 Review Date: March 2013
Location of Hard Copies/Points of Use: AMMC, FV Amaltal Explorer		

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SECTION 1. VOYAGE OVERVIEW

1.1 Project background

The Antarctic Division of the Australian Government is conducting an Antarctic Blue Whale Voyage in the austral summer of 2013. This voyage is the first in a series of voyages that are part of the Antarctic Blue Whale Project (ABWP). The AWBP is an international initiative which aims ultimately to deliver a new circumpolar abundance estimate for Antarctic blue whales (*Balaenoptera musculus intermedia*). Additional objectives are to improve our understanding of their population structure and linkages between breeding and feeding grounds, and to characterise their behaviour in the feeding grounds. The ABWP is a flagship research program of the Southern Ocean Research Partnership (SORP), a consortium of six collaborative research programs, led by Australia under the International Whaling Commission. Nations in the partnership to date include Argentina, Australia, Brazil, Chile, France, Germany, New Zealand, Norway, South Africa and the United States.

During the twentieth century, approximately one third of a million Antarctic blue whales were taken during commercial whaling in the Southern Hemisphere. Close to extinction, in 1964 the International Whaling Commission banned the hunting of blue whales, although some whales were still caught by illegal operations until 1973. Today, the Antarctic blue whale is classified as critically endangered by the International Union for Conservation of Nature and is of global interest as one of the most at risk baleen whale species in the Southern Ocean.

The catch records from the whaling fleets and subsequent Antarctic sightings surveys allow the reconstruction of the rapid depletion and very slow recovery of Antarctic blue whales but a new precise abundance estimate is required to assess the current status of these whales. As systematic sightings surveys are no longer conducted around Antarctica, this project's first objective is identify the most appropriate and efficient approach to derive a new abundance estimate for Antarctic blue whales. Initial analyses suggest a mark-recapture based effort is the most feasible method and will also provide an opportunity to deliver important information on the project's secondary objectives of investigating population structure, migratory movements and behaviour on the feeding grounds. However further development of mark-recapture survey techniques will be required. This ABWP is ambitious and will require coordinated and sustained international cooperation to deliver the necessary data to achieve a new abundance estimate for Antarctic blue whales.

The 2013 Antarctic Blue Whale Voyage is the first in a series of voyages that will combine acoustic tracking with satellite tagging, photographic and genetic identification, to begin determining the most appropriate methods and collect data towards a new circumpolar abundance of Antarctic Blue whales. The data will also provide further information on the population structure, linkages between breeding and feeding grounds, and the behaviour in the feeding grounds of Antarctic blue whales.

The 50 day voyage will depart from Nelson, New Zealand in late January 2013. The voyage will focus on Antarctic blue whales found at the ice edge in the survey region west of the Ross Sea (approximately 135–175°E). Analyses of historical catch data, IWC-IDCR/SOWER sighting data and sonobuoy deployments suggest that his area has been associated with higher densities of blue whales.

The Australian Antarctic Division will charter from Gardline Australia, the FV Amaltal Explorer, an ice-classed stern trawler owned and operated by Talley's in New Zealand. This vessel will carry 18 scientists and about a 15-person crew.

1.2 Voyage Schedule

Time allocations to activities occurring during the 50-day charter period:

Details	Location	Arrive	Depart	Time allocation
On hire; load cargo	Nelson, NZ	28-Jan-2013	29-Jan-2013	2 days
Transit	135–175°E	29-Jan-2013	4-Feb-2013	7.5 days
Science Objectives 1 to 4	135–175°E	5-Feb-2013	10-Mar-2013	33 days
Science Objectives 5 to 8	135–175°E	5-Feb-2013	10-Mar-2013	Opportunistic
Transit	Ross Sea	11-Mar-2013	17-Mar-2013	7.5 days
Unload cargo; off hire	Nelson, NZ	17-Mar-2013	18-Mar-2013	2 days

1.3 Prioritised research objectives

The eight prioritised research objectives for the 2013 Antarctic Blue Whale Voyage are:

Objective 1. To assess and refine passive acoustic methods for locating Antarctic blue whales
Objective 2. To collect photographic data and biopsies for individual identification of blue whales
Objective 3. Linking blue whale calls to their behaviour and environment
Objective 4. Collect distance sampling data for regional abundance estimate of cetacean species
Objective 5. Deploy satellite tags to describe the movement and behaviour of blue whales
Objective 6. Collect Antarctic krill (*Euphausia superba*) for krill ecological genomics study
Objective 7. Testing of kite-antenna for improved sonobuoy radio reception
Objective 8. Evaluate the body condition of humpback whales from biopsy samples

Details on the methods to address each objective are provided in Sections 2 to 10 of this Science Plan.

Guiding principles for time allocation

- Given the aim of the Antarctic Blue Whale Project Objectives 1 and 2 should, by far, receive the most attention during this voyage.
- Little time should be dedicated to addressing Objectives 3 and 4; rather these objectives will be addressed in the process of addressing Objectives 1 and 2.
- Objective 5 is worthy of dedicated voyage time once strong inroads have been made in Objectives 1 & 2. This is currently a ‘lower’ objective in recognition of the requirement to launch and retrieve the RHIB which is time consuming. Successful deployment of satellite

tags on blue whales would be a 'first' and deliver new insights into the behaviour of blue whales.

- Objectives 6 to 8 should be addressed in such a manner that there is very little or no impact on the other five objectives.

1.4 Study area

The 50 day voyage aims to locate blue whales within the survey region west of the Ross Sea (approximately 135–175°E). Analyses of historical catch data, IWC-IDCR/SOWER sighting data and sonobuoy deployments suggest that his area has been associated with higher densities of blue whales. See Section 2.3 for further details on the study area and spatial modelling of catch and sightings data.

1.5 Voyage and science personnel - roles and responsibilities

List positions responsible for activities identified in this procedure with a brief description of their roles.

Number	Name	Primary role	Additional role(s)
1	Chris Galloway	Voyage leader	
2	Margaret Lindsay	Deputy Voyage Leader	
3	Jay Barlow	Science leader	Acoustician
4	Cath Deacon	Doctor	Observer
5	Brian Miller	Lead acoustician	
6	Paula Olson	Lead observer	Biopsy (ship)
7	Mick Davidson	Lead coxswain	Visual media
8	Virginia Andrews-Goff	Data manager	Observer; tagging; biopsy (RHIB)
9	Victoria Wadley	Media liaison	Data manager; observer
10	Susannah Calderan	Acoustician	
11	Kym Collins	Acoustician	
12	Russell Leaper	Acoustician	Observer training
13	Dave Donnelly	Coxswain	Observer; biopsy (ship)
14	Paul Ensor	Observer	Biopsy (ship)
15	Carlos Olavarria	Observer	Acoustician; biopsy (ship)
16	Kylie Owen	Observer	
17	Melinda Rekdahl	Observer	Acoustician; Tagging; biopsy (ship & RHIB)
18	Natalie Schmitt	Observer	Visual media

From a science perspective on this voyage there are four key teams:

Science leadership team (JB, PO, PE, BM, RL, MD, VW; + VL & DVL)
Acoustics team (BM, RL, KC, SC, JB, CO, MR)
Observations team (PO, PE, CO, KO, MR, NS, DD, MD, CD)
Small boat team (MD, DD, VA-G, NS, MR)

1.6 Modes of operation

Throughout daylight hours the voyage the vessel will have nine modes of operation. These are:

1. Visual Transect (VT)
2. Visual Transect Bridge only (VT-BO)

3. Acoustic Bearing (AB)
4. Visual Bearing (VB)
5. Survey Aggregation (SA)
6. With Whales (WW)
7. Close Approach (CP)
8. Small boat (SB)
9. Acoustics only (AO)

Further description of these modes is provided in Table 1 and Figure 1. Full details of these modes and the rules to move between modes are provided in Section 6.3.

1.7 Hours of operation

During daylight hours the Observation and Acoustics team will be on roster but at night only the Acoustics team will be active. The numbers of hours of observing per day will depend on local day length, see Figure 1, but must operate within the rules of Fatigue Management (see AAD ABWV Concept of Operations: Appendix 6 Fatigue Management Policy). During the survey the operational day lengths will decrease approximately as follows:

- Week 1: 19 hours per day
- Week 2: 18 hours per day
- Week 3: 17 hours per day
- Week 4: 16 hours per day
- Week 5: 15 hours per day

For proposed rosters during days with the longest daylight hours see Section 12.

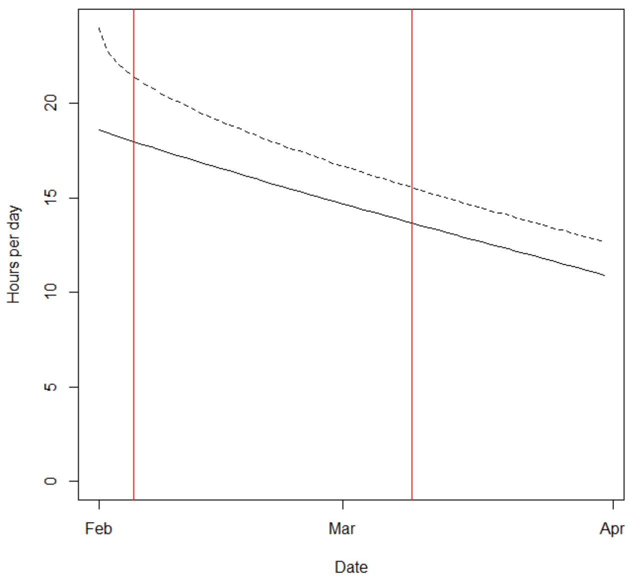


Figure 1. Hours of 'daylight', from sunrise to sunset (solid line) and for 'daylight + civil twilight' (dashed line), for the area 135°-175°, at around 67°S, for February and March, 2013.

1.8 Key voyage documents

- 2013 Antarctic Blue Whale Voyage Concept of Operations Document (CONOPs) – Project 4012
- AAD Ops Service Level Agreement Process
- AAD Standard Operating Procedures (SOP) 2012 Shipping
- AAD Standard Operating Procedures (SOP) Antarctic Blue Whale Voyage Small Boating
- AAD Standard Operating Procedures (SOP) Antarctic Blue Whale Voyage Firearms
- AAD Standard Operating Procedures (SOP) Antarctic Blue Whale Voyage Sonobuoys
- AAD Standard Operating Procedures (SOP) Antarctic Blue Whale Voyage Kites
- JHA 2013 Antarctic Blue Whale Voyage
- AAD Voyage Brief 2013 Antarctic Blue Whale Voyage
- Communication plan Antarctic Blue Whale Voyage
- Project Risk management (AAD)
- Project plan Tier 3 (AAD)
- Operational Documents (Gardline and Talley's)
- AAD Environmental Policy (AAD)
- VWHALE Expeditioners Code of behaviour (AAD)
- AAD Expeditioners Handbook (AAD)

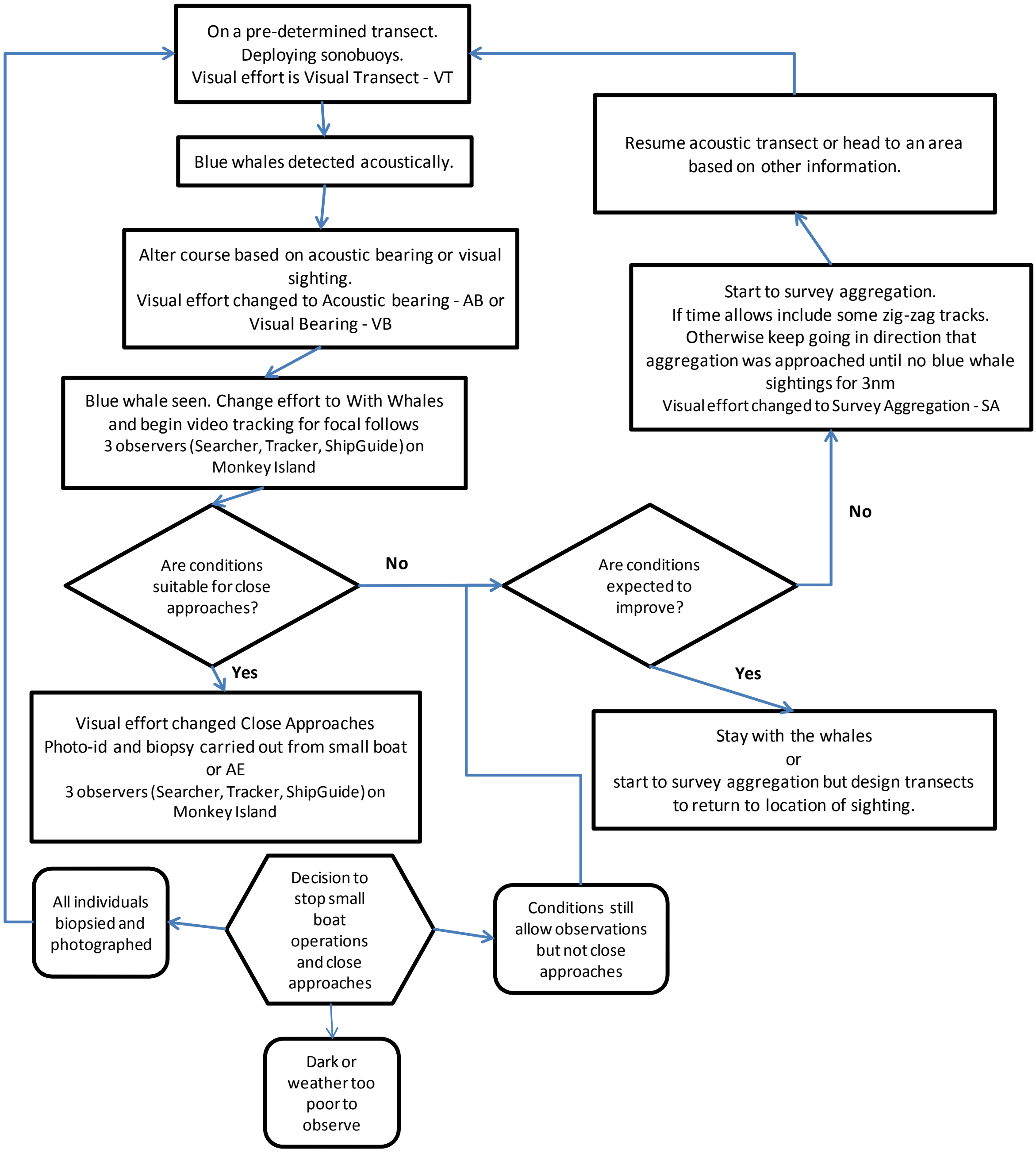
1.8 Key voyage permits and licences

Environmental Protection and Biodiversity Conservation Act (EPBC - permit number C12-0006)
Antarctic Animal Ethics Committee (AAEC – permit number 4102)
Tasmanian firearms permits and licences
AQIS (currently expires 20/4/2013)
CITES AUS Export permit
CITES NZ Export permit
NZ Department of Conservation permit to hold marine mammal material
NIWA Animal Ethics Permit
AQIS Import Permit IP12013998 - import preserved marine invertebrates to the AAD.
AMLR /CCAMLR Permit – part of EIA application form 41014102

Table 1. Description of the modes of operation and associated activities during the voyage. Confer with Figure 1 and Section 6.3.

Mode	Hours of Operation	Activities	Weather conditions	Who is 'guiding' the ship?
Visual Transect (VT or VT-BO) or Acoustic Bearing (AB) or Visual Bearing (VB)	Daylight hours	Acoustics team deploying sonobuoys and listening for blue whales. Observing team on Flying Bridge and/or Bridge	Observing on the Flying Bridge will occur for < Beaufort 5. Bridge only > Beaufort 5. No sightings > Beaufort 6. Acoustics will occur when Beaufort <7, unless otherwise unsafe to deploy sonobuoys	Acoustics team according to their tracking and targeting protocols or if whale sighted without acoustics bearing then the sightings team will guide the vessel. In the event no blue whales detections the vessel will be directed by the spatial model i.e., heading back towards or along the sea ice boundary
With Whales (WW)	Daylight hours	Once sighting is confirmed as a blue whale then observation team switches to WW mode and starts video tracking Decision required whether to switch to Close Approach, Small Boat or Survey Aggregation mode	likely < Beaufort 6	Ship guide - an observer on Bridge or Flying Bridge
Close approach (CP)	Daylight hours	Decision required whether Photo-ID only or Biopsy and Photo-ID Potentially collecting photo-ID and biopsies from bow Remaining observing team will maintain observations from the Flying Bridge Acoustics team deploying sonobuoys and listening for blue whales, as required	likely < Beaufort 6	Ship guide - an observer on Bridge or Flying Bridge
Small boat (SB)	Daylight hours	Potentially collecting photo-ID and biopsies from bow Biopsies and photo-ID may also be captured from the ship	likely < Beaufort 5	Ship guide - an observer on Bridge or Flying Bridge Ship must remain in visual contact with small boat
Survey Aggregation (SA)	Daylight hours	The aim is to estimate the extent and numbers of whales within an aggregation. This survey mode will only be undertaken when it is not possible to approach individuals for photo-id or biopsy either with AE or the small boat This will be based on short track lines within the aggregation area.	likely > Beaufort 6	Lead observer will design small scale tracklines within a limited area of the aggregation
Acoustics only (AO)	Outside daylight hours	Acoustics team deploying sonobuoys to locate new, or remain with blue whales	Up to Beaufort 7, unless otherwise unsafe to deploy sonobuoys	Acoustics team according their tracking and targeting protocols.

Figure 1. Flowchart for changes in effort modes for the voyage



SECTION 2. PROCEDURES TO MEET OBJECTIVE 1 – LOCATING BLUE WHALES

2.1 Purpose

Objective 1. To assess and refine passive acoustic methods for locating Antarctic blue whales

The ultimate goal of this voyage is to employ refined methods to locate and individually identify as many blue whales as possible. The individual identification data will contribute to a multinational effort to estimate the circumpolar abundance of blue whales using mark-recapture methods.

2.2 Operational and Safety Resources

For specific SOPs and JHA see Section 1.8.

All SOPs and the voyage JHA will be distributed to all personnel prior to the voyage. The documents and associated procedures will be constantly under review and updated during the voyage so the identified risks to personnel are mitigated appropriately.

2.3 Survey Area – targeting a blue whale 'hotspot'

Spatial modelling

Using circumpolar spatial models, which explore the seasonality and location of historical sightings and catches (derived mainly from IWC-IDCR/ sightings, IWC-IDCR/SOWER acoustical detections of Antarctic blue whales, and IWC catch data for Antarctic blue whales) 'hotspots' have been identified that may have relatively higher densities of Antarctic blue whales (Kelly et al., 2012). These hotspots are at a large spatial scale (i.e., a number of 10s of degrees of longitude) and will determine the bounds of potential study sites for the Antarctic Blue Whale Project.

For this voyage, the general area (hotspot) targeted is approximately 135-175° E, between the ice edge (roughly defined as the 15% sea ice concentration contour) and north to a distance of around 200 km (but as far north as 60°S if Antarctic blue whales are detected there).

Details of the circumpolar spatial model of the distribution of Antarctic blue whale densities, with a focus on the study region for this voyage, is available in GIS form (see Section 2.12) to assist with any large-scale decisions about guiding the vessel during the survey.

It should be noted that:

- The survey effort will be targeted within 200 km of the sea ice boundary while recognising the sea ice boundary can be highly dynamic over temporal scales of a month, a week, or even a day.
- The spatial model should be used to guide the vessel if few or no Antarctic blue whales can be seen or heard.
- If Antarctic blue whales are observed (or acoustically detected within a reasonable range) before entering the study area then the ship would alter course to collect identification samples from these animals (see Objective 2: To collect photographic data and biopsies for individual identification of blue whales).

Survey design within study region

Using sea ice satellite data (Data Manager's laptop and HDD-Logger), the survey will focus on the area between the sea ice edge (see Figure 2), out to a distance of 200km north (see Figure 3). The survey design will not seek to attain spatially even coverage but will be highly adaptive depending on when/where acoustic detections/observations of Antarctic blue whales occur. However, in the event that blue whales cannot be acoustically detected the survey should follow along the sea ice boundary, in a zig-zag pattern to deliver broadly even coverage of the area (see Figure 4).

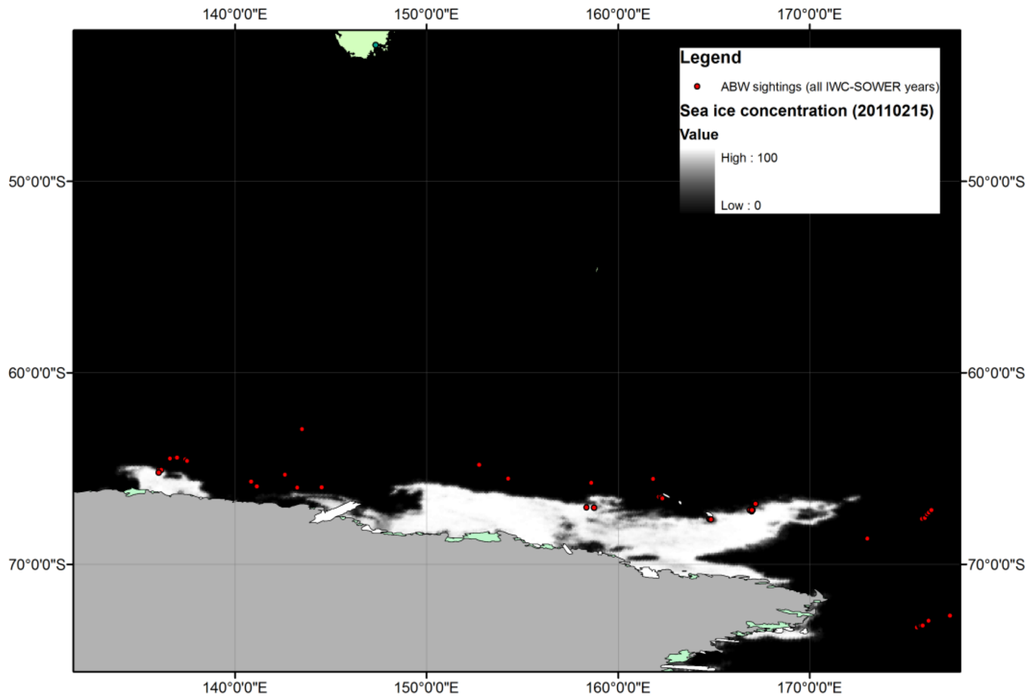


Figure 1. A typical sea ice configuration for mid-February, as represented by AMSR-E sea ice data for 15 February, 2011. Red dots represent all blue whale sightings recorded throughout the IDCR/SOWER surveys.

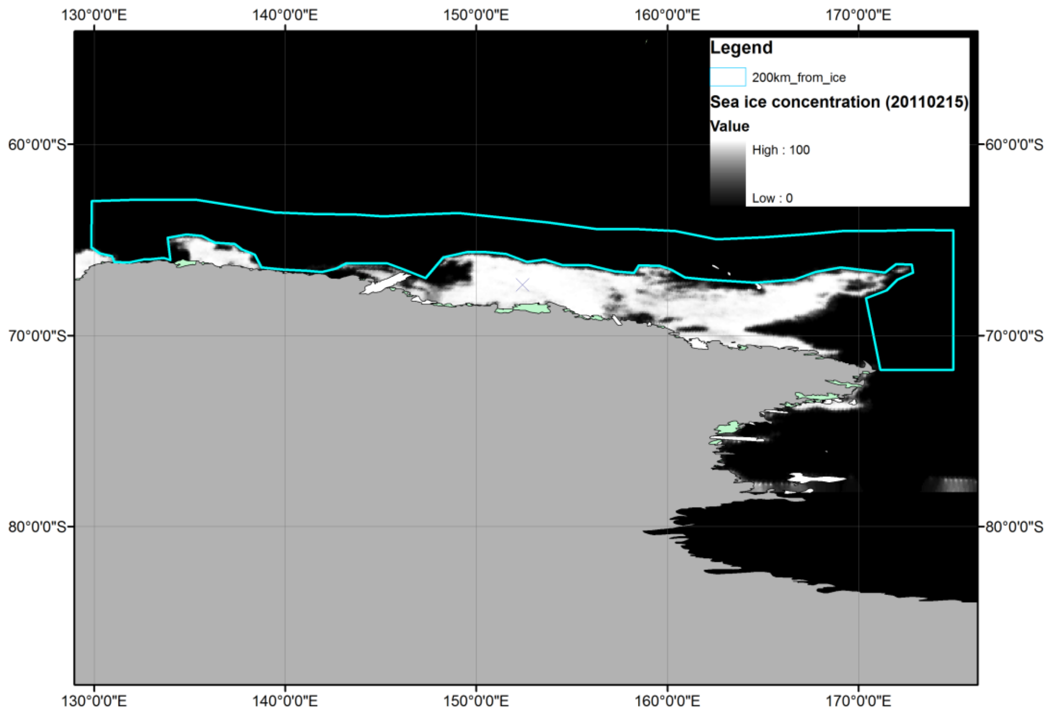


Figure 2. Region representing approximately 200 km from the sea ice boundary, as observed, using AMSR-E satellite data, on 15 February, 2011.

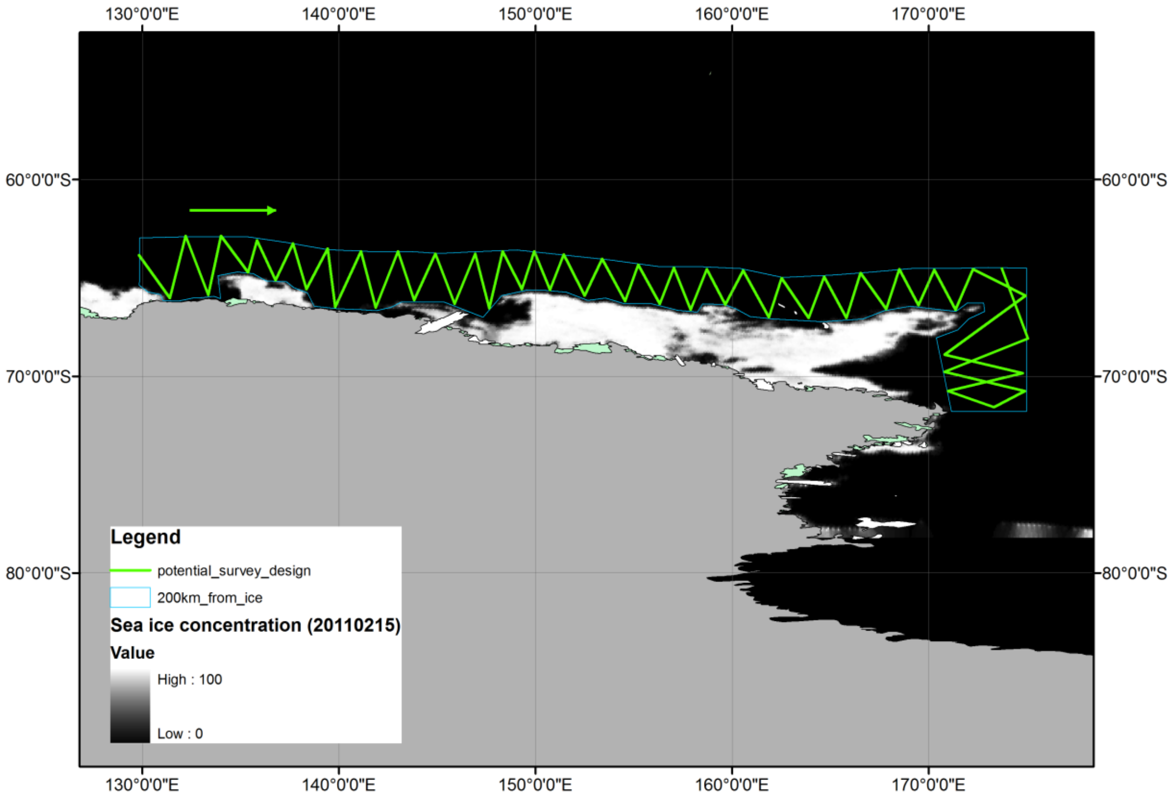


Figure 3. A potential survey design (hand drawn), in the unlikely event that passive acoustics are not helpful in locating Antarctic blue whales. Direction of travel is from west to east. Total survey length is around 7370 nautical miles.

Survey direction within study area

According to Discovery mark data plotted in Branch *et al.* (2007) it would seem that Antarctic blue whales tend to be moving from east to west in a single season in east Antarctica. Therefore, unless otherwise guided by acoustic detections, starting from the west and moving east within the study area would be the best strategy in order to encounter as many different individuals as possible.

2.4 Data collection and weather

Weather observations from IWC-IDCR/SOWER voyages in the 135°-175°E region can provide a guide to the proportion of time that may be available for collection observational and acoustics data. On IWC-IDCR/SOWER voyages weather observations were taken every hour, between 5 or 6 am, and 8 pm, local time. IWC-IDCR/SOWER voyages generally operated from early January through to mid February so the amount of good weather may be optimistic if weather conditions start to deteriorate into the autumn period.

The percentages of time by weather type are given in Table 1. The variable 'sightability' was selected as an overall descriptor of the quality of observing conditions, and is a compound variable that describes the overall ability to see cetaceans and includes Beaufort Sea State, glare, ambient light levels, mist or fog, and so on. It is graded from 1, being very poor or no chance of seeing whales that are in the area; 2 is poor; 3, fair; 4, good; and 5, excellent. Periods of time when Beaufort Sea State is low, but a sightability score is also low, represent times of fog, snow or mist.

Under the assumption that weather recorded between 5 am and 8 pm is generally representative of weather experienced throughout the 24 hour period, then around 93% of the time (on a 24 hour working day) will be available to conduct passive acoustic work (i.e., Beaufort Sea State ≤ 6). Around 46% of daylight hours will be available for observing from the Flying Bridge (i.e., Beaufort Sea State ≤ 4; sightability of ≥ 2), and a further 7% of the daylight hours from the Bridge when Beaufort Sea State is 5-6 and sightability is 2-5.

Table 2. Percentage of time in each combination of Beaufort Sea State (rows) and general sightability (columns) categories, as observed by the IWC-IDCR/SOWER surveys when working within 200 km of the extant ice edge, within the region 135-175E, between 5 am and 8pm, from early January to mid February. All gray areas indicate the combinations that would allow passive acoustic monitoring; mid-gray cells represent combinations that would allow observing to occur from the Flying Bridge; darkest shade of gray for weather conditions when observing would have to occur from the Bridge; and white indicates time when no observing/passive acoustics activities will be possible.

Beaufort Sea State	1	2	3	4	5	Total
0	0.3	0.0	0.0	0.2	0.1	0.6
1	1.1	0.3	1.5	1.5	0.0	4.5
2	3.0	1.8	4.1	4.5	0.3	13.6
3	6.6	4.1	8.8	4.0	0.9	24.3
4	12.0	7.2	5.2	1.3	0.0	25.7
5	9.6	3.5	1.0	0.2	0.0	14.2
6	8.4	1.7	0.2	0.0	0.0	10.3
7	5.2	0.2	0.0	0.0	0.0	5.3
8	1.4	0.0	0.0	0.0	0.0	1.4
9+	0.1	0.0	0.0	0.0	0.0	0.1
Total	47.5	18.7	20.7	11.7	1.4	100.0

2.5 Methods - Observations during survey

Full details of observer protocols and training are provided in Section 6.3

In summary:

- members of the Observations Team will work to a roster during 'daylight hours' to record blue whales, other marine mammals, seabirds, krill, and environmental data.
- whenever possible formal Distance Sampling protocols will be followed.
- the observers will work from the designated observer platform on the Flying Bridge or, if sighting conditions are relatively poor or variable, on the Bridge.

2.6 Methods - Passive acoustics

Background

Passive acoustics involves the use of underwater listening devices to detect and locate calling animals. Antarctic blue whales frequently make extremely loud, repeated calls that can be heard over a greater range than they can be seen by a visual observer on a ship.

The main purpose of passive acoustics on this voyage will be to:

- detect and locate calling blue whales
- provide baseline information about Antarctic blue whale vocalisations, i.e.

  How loud are they?
  How long do whales continue to call?
  How do number of whale calls relate to number of whales photographed and any observed behaviour?

AN/SSQ DIFAR 53D sonobuoys will be deployed throughout the research area at four to six hour intervals by the acoustician on-duty (see SOPs and JHAs for storing, transporting, and deploying sonobuoys). Upon detection of Antarctic blue whales, sonobuoys will be deployed more frequently in an adaptive fashion in order to facilitate real-time tracking of vocalising whales.

The range (distance) over which sonobuoys can detect whales is expected to be much greater than the range over which the research vessel can receive VHF telemetry from the sonobuoys, so each targeted whale will likely require multiple sonobuoy deployments. The precision of the real-time acoustic tracking system varies according to a number of environmental factors. Estimates of detection range may be improved with knowledge of the sound speed profile which will be obtained via a daily CTD or SVP cast assisted by vessel crew. Bearings from sonobuoys are accurate within ±10° (standard deviation 4.7°), and during trials, triangulations from multiple buoys were typically within a few kilometres of sightings.

Deployment and calibration

Responsible: Duty lead acoustician

- Passive acoustics will be conducted 24 hours/day, weather permitting
- For each sonobuoy deployment, the acoustician will fill out the appropriate sections of both the electronic Sonobuoy Deployment Log file and a written Sonobuoy Event Log (see Sections 11.5 and 11.6).
- Data recorder will record the timestamp/location and number of the sonobuoy deployment in Logger
- If data recorder is not on duty, acoustician will record the timestamp/location and number of the sonobuoy deployment in Logger
- Audio from deployed sonobuoys will be recorded and monitored in real-time using dedicated VHF receivers connected to an acoustic tracking workstation.
- Upon deployment, the acoustician on-duty will 'calibrate' the sonobuoy to correct for the local magnetic declination and deviation of the internal compass within the sonobuoy. This will be achieved by measuring the bearing to the vessel as it continues along the trackline, moving away from the buoy at the regular cruising speed.
- During the calibration it is useful for the vessel to maintain constant engine revs in order to maintain a consistent acoustic signature.
- The calibration process usually takes 5-10 minutes for each buoy. For more information about calibration, see Miller (2012).

Triangulation

After calibration of the sonobuoy, the acoustician on-duty will analyse incoming vocalisations to obtain bearings from the sonobuoy to all detected whale vocalisations.

- Bearings from multiple sonobuoys will be used to triangulate the location of the whales (Latitude, Longitude WGS84).
- Acousticians will note all whale calls in a Sonobuoy Event Log (see Section 11.6), including any additional information that may be useful for tracking and 'targeting' (eg., sightings of whales, sonobuoys or other vessels, acoustic, electrical, or radio noise, gear failure, etc). The acoustic tracking software will store all acquired bearings, and cross bearings in text files.

Course of action on hearing whales

- The acoustician on-duty will formulate a course of action in conjunction with the science lead, voyage leader and officer on watch. The acoustician on-duty, lead acoustician, or science lead will, in conjunction with the voyage leader, use clear, concise and timely communication to direct the officer on watch to follow the agreed upon course of action.
- The course of action will involve directing the vessel to:
    1. A new location to deploy another sonobuoy (e.g. head southwest for 15 miles for a buoy deployment at approximately 0800h)
    2. Follow a bearing in order to encounter a whale (e.g., steer a course 270 T)
    3. Proceed to a location of a whale or target of interest (e.g., got to target at 67.12345S,163.67890E)
    4. Start a 'local search' for a whale (e.g., I believe there is a whale nearby, so steer a search pattern over this area to help visual observers locate a whale).
- Upon providing directions, the ship effort mode should be changed to Acoustic Bearing (AB) mode
- Similarly, if the course of action no longer involves acoustic control of the ship, the ship effort mode should be changed to Visual Transect (VT) mode
- Changes in ship effort should be entered in Logger by the bridge data recorder or by bridge crew or an Acoustician outside of daylight operating (observer) hours

Targeting a single whale from multiple calls

- If multiple whales are detected, then the acoustician on-duty, in consultation with the lead acoustician and/or voyage management will designate one of the whales the 'target' whale, and will attempt to encounter this target first.
- When targeting a whale, the acoustician on-duty will continue to track all other whales in the area as these tracked whales may become the next target after obtaining concluding with the current target.
- The acoustician on-duty will record the average bearings or locations of each calling whale every 15 minutes in the written Whale Tracking Log.
- Entries in the written Sonobuoy Tracking Log (on the bench in the acoustics workstation) will also include total number of different whales heard in that 15 minute interval.

Visual detection of a blue whale

Upon visual detection of a blue whale(s), the acoustician on-duty will:

- Confirm whether the whale that has been seen is the target
- Confirm with visual observers and/or voyage management that visual observers are now responsible for determining the course of the vessel
- Continue tracking the target group and all other whales as usual, communicating relevant developments in tracked whale movements to the visual observers and voyage management
- Continue to deploy sonobuoys strategically and opportunistically subordinate to vessel movements for confirming species ID, group composition and behaviour, and any attempts for photographing and biopsying the Antarctic blue whales.

Example communications with Bridge - deploying a sonobuoy

Acoustician: “PREPARING TO DEPLOY SONOBUOY X”

Data recorder: Enters sonobuoy number into sonobuoy deployment event; “GO AHEAD WHEN READY”

Acoustician: Prepares sonobuoy, and immediately after deployment says, “SONOBUOY X HAS BEEN DEPLOYED”

Data recorder enters the event, marking the time and position, and repeats back: “SONOBUOY X DEPLOYED AT HH:MM

Skipper: Marks the deployment location on the navigation computer on the bridge

CTD/Sound velocity profiles

In order to collect supplementary information on the sound speed profile, which is useful for post-processing of acoustic data, a very small and portable mini-CTD will be deployed once every 24 hour period.

- Before CTD deployment, the acoustician will consult with voyage management and/or the officer on watch
- CTD deployments will make use of a powered winch and drum and will be assisted by vessel crew.
- CTD will be deployed to 1000 m and retrieved as quickly as possible.
- Data from the CTD will be downloaded to the acoustics workstation and backed up with acoustic data
- CTD deployments will ideally take place at night when no visual observations are being collected

2.7 Data collection

Observation team

See Section 6.3

Acoustics team

- The Acoustics Team will complete the following record sheets as per the protocols above:

  Written Sonobuoy Deployment Log (Section 11.5)
  Electronic Sonobuoy Deployment Log (Section 11.5)
  Written Sonobuoy Event Log (Section 11.6)
  Written Sonobuoy Tracking Log (Section 11.7)

- Raw and derived acoustic data will be stored on the Acoustic Workstation in subfolders under the folder c:\data\.
- Raw data include:
  - Sonobuoy deployment locations and metadata
  - raw audio
  - raw NMEA 0183 sentences recorded from the GPS unit
  - downloaded files from the CTD/SVP
- Derived data include:
  - Compass correction for sonobuoys

Audio clips of whale calls,
Time and bearing to whale calls
Time and position of triangulations of whale calls
Maps (PNG format) of bearings, ship track, and sonobuoys

- The entire folder c:\data\ (including all subfolders) will be backed up daily to external hard disks.
- The raw NMEA 0183 data from the acoustics GPS unit will be recorded as a text file called c:\data\gps\gpsNmea.txt. The NMEA sentence $GPRMC is required by the real-time acoustic tracking software.

2.8 Data management

- The Lead Acoustician or delegate will make back-up files of the electronic Logfiles, the NMEA GPS data and sound files each day to the external hard drive labelled "Acoustics Backup".
- Data managers will ensure the Acoustic team is regularly backing up all electronic data listed above.

2.9 Roles and responsibilities

Observing team

See Section 6.3 and 12.3.

Acoustics team

The lead acoustician (or duty lead acoustician) will be responsible for:

- Management of acoustics roster (to mitigate fatigue/illness)
- Strategic and timely analysis of real-time acoustic tracking data
- Continuity and consistency of acoustic data collection and interpretation
- Integration of acoustic tracking with other data streams
- Communication with voyage management to determine vessel course (ie. spatial sampling strategy)
- Acoustic data management (quality control, data integrity, and daily backups)

All duty acousticians will be responsible for:

- Continuous operation of the real-time passive acoustic tracking system
- Deployment and calibration of sonobuoys and completion of Sonobuoy Deployment Logfile
- Real-time monitoring of audio from deployed sonobuoys and localisation of whale calls
- Completion of written log of all whale calls (Sonobuoy Event Log) and entries every 15 minutes in the Whale Tracking Logbook.
- Assisting crew with daily CTD/SVP deployment and downloading data.
- Clear, concise, and timely communication of desired course-of-action to voyage leadership
- Acousticians on-call may be required to temporarily fill in for on-duty acousticians, work as observers, or asked to assist with data management. Acousticians with appropriate training and certifications may also collect identification photographs and biopsy samples while on-call.

Data management

The data manager will be responsible for:

- Observer and acoustics data quality control and integrity, and backing up Logger and GPS data at least daily.
- Management of other associated data streams (e.g. observer calibration data – see Section 6.3)
- Integrating sighting, effort and environmental data into GIS archive
- Timely reporting of up-to-date observational data to voyage management
- Data manager, in consultation with lead observer, will also regularly check for problems in observing protocols using sighting and effort data.
- Overseeing the archiving of general photographs (but see Objective 2: photo-ID and biopsies), and video (i.e., for media, shared images, etc)

2.10 Personnel rosters

See Sections 12.1 and 12.2 for the Observations and Acoustic Team rosters respectively.

2.11 Training

All team members must be trained and inducted in use of machinery & equipment required for this procedure, including PPE. Training & maintenance records must be kept in accordance with AAD Records Management Policy

The VL and DVL are responsible for ensuring team members understand the SOP's objectives and other interrelated activities.

Observer team

Training in observer protocols will occur prior to departure with further practice and refinement on the vessel when underway. Lead observer and RL will conduct observer training.

Acoustics team

BM will lead training for the acoustics team. Training will include the use of a simulated environment used to familiarise the team with the equipment, data collection and decision rules.

2.12 Data resources

Each of these data resources is available on the Data Manager's laptop and on the external hard drive named 'HDD-Logger'.

- GIS 1 min bathymetry raster (120E-160W).
- GIS bathymetry polyline shapefiles (circumpolar)
- GIS shapefiles defining coastlines, ice sheets, islands, etc. (circumpolar)
- GIS gridded sea ice data in .csv format (a product I derived from AMSR-E and SSMIs data) for 2003-2013, every 2 weeks, from mid December through to late March (120E-160W)
- GIS Southern Ocean fronts (circumpolar)
- GIS general location of the south magnetic pole (csv format)
- GIS IDCR/SOWER tracklines (not separated into CP series)
- GIS IDCR/SOWER ABW sightings (all sightings; separated into CP series, and classified into group sizes)
- 'GeoReffing' tool which takes the SSMI and MODIS images and allows them to be imported into ArcMap
- Weekly sea ice appraisals: each Thursday evening, an appraisal of the extant sea ice conditions in the blue whale voyage study region will be delivered to the ship as a raster file

2.13 Equipment

See Section 13.1 for list of Observations equipment
See Section 13.2 for list of Acoustics equipment

SECTION 3. PROCEDURES TO MEET OBJECTIVE 2 – PHOTO-IDENTIFICATION

3.1 Purpose

Objective 2. To collect photographic data and biopsies for individual identification of blue whales.

Individual identification allows the production of sightings histories required for a mark-recapture approach to estimating abundance. These data will also provide information on blue whale population structure and movement.

Individual blue whales are identifiable from unique patterns of mottled pigment on both sides of the body, and also from variations in dorsal fin shape and any permanent scars that may be present.

3.2 Operational and Safety Resources

For specific SOPs and JHA see Section 1.8.

All SOPs and the voyage JHA will be distributed to all personnel prior to the voyage. The documents and associated procedures will be constantly under review and updated during the voyage so the identified risks to personnel are mitigated appropriately.

3.3 Photo-identification methods

- Photo-identification images of blue whales will be collected whenever feasible during the voyage, from both the ship and a small boat deployed from the larger vessel.
- Try to capture **both** sides of each individual whale.
- When blue whales are sighted photo-ID may be conducted as the sole effort or in conjunction with biopsy and tagging, depending on weather and other operational considerations.
- Digital SLR cameras will be used to collect the images.
- Blue whales will be photographed at an angle perpendicular to the whale, capturing the pigmentation in the area of the dorsal fin. All biopsied and tagged whales will be photographed.

Camera settings

Responsible: PO, PE

- Set cameras with UTC date and time synchronized to Logger's GPS reading. Check synchronization every morning.
- Set file type for **high (or fine) quality JPEG** – this is used to simplify file manipulation and management of files from the various camera manufacturers.
- Set file numbering as continuous and file naming as close to that specified below.
- Do not reset numbering until the end of the day and preferably use different prefix each day.

- Shutter priority with ISO400 and shutter speed 1000th sec is a good place to start for the generally overcast days in the Antarctic. Adjust settings as needed based on the lighting. The automatic sports action mode also works well for photographing moving cetaceans.
- Check the camera's batteries and be sure there are freshly charged ones available. Battery power deteriorates quickly in freezing temperatures.

Photography of blue whales

- Keep the sun behind you. if the whale is backlit adjust the camera settings (i.e. set compensator +1 stop, or bump up ISO setting and reduce shutter speed).
- Photograph the entire side of the whale, at a directly perpendicular angle, keeping in mind that the most important shot is that of the dorsal with the surrounding pigmentation.
- Photograph any unusual scars regardless of where they occur on the body.
- Photograph both sides of the whale.
- Photograph all biopsied and tagged whales even if a true perpendicular angle cannot be obtained.
- Take a shot of the current Sighting Number Flip Chart or a whiteboard with the current sighting number **prior** to taking photos of a pod/sightings.
- Shoot a spacer (a subject inside the boat, an iceberg, etc.) between individual whales within a pod. This aids in sorting the photos later.

Example photograph

Pygmy blue whale © Michael Double

Other species

Photographs of other species of cetaceans will be collected when possible, particularly species (listed below) that are the subject of other research projects and in addition rarely sighted species such as beaked whales (Ziphiidae), pygmy right whale (*Carperea marginata*) and spectacled porpoise (*Phocoena dioptrica*).

- Humpback whale (*Megaptera novaeangliae*) - photographs of the ventral flukes or the dorsal fin (perpendicular angle) if the whale does not fluke up
- Southern right whale (*Eubalaena australis*) - photographs of the callosity patterns on the head, ideally from above but also from the side

- Killer whales (*Orcinus orca*) - photographs of the lateral sides of the animal including the eye patch, cape, dorsal fin and saddle patch behind the fin (perpendicular angle)

3.4 Data collection

- Photo-ID data collected from the ship will be recorded on the written Photo-Identification Datasheet available on the Photo-ID laptop; this should be later transcribed into the Photo-ID Access Database .
- The start and finish time for collecting Photo-ID data from the ship should be recorded in Logger; this will automatically record the lat/long of the ship.
- Photo-ID data collected from the RHIB will be recorded on the written RHIB Datasheet (see Section 11.8) then transcribed to the Photo-ID Access Database on the Photo ID laptop (see Section 11.11).

3.5 Data management

Databases

- Photo-ID data collected on the ship or small boat will be transferred from the written data sheets (see above) into Photo-ID Access Database located on the Photo ID laptop (communal computer area) by the observers and small boat data person each day.
- This database will be backed up daily on an external hard drive (HDD Photo-ID) by the Data Manager.

Archiving photos and associated data

- Each photographer will archive her/his photos and transfer them to the Photo ID laptop using the USB stick provided during the pre-voyage training. Additional USB sticks are available from the Data Managers.
- Each photographer must ensure that photo details are entered both on the datasheet (small boat or main vessel photo) and in the database on the Photo ID computer.
- Photographers will be able to use the 'batch rename' function in Adobe Photoshop Elements (on the Photo ID computer) to label images using the following format to create a unique identifier for each image based on voyage, date, photographer's initials, and a daily sequential number i.e. :

  13BW_20130212_MCD_001

  where 13BW is the voyage identifier _YYYYMMDD is the date identifier _MCD is the photographer's initials_001 is the daily sequential number.

- Renamed images will be stored on the Photo ID laptop and backed up daily on the Photo-ID HDD by the Data Manager.
- Images will be stored in the folder for the appropriate species (e.g. 13BW_Blue, 13BW_Humpback, 13BW_SouthernRight) by sighting number.
- Within the species folder there will be a subfolder for each sighting (sighting number derived from Logger), e.g. 13BW_Blue_021; 13BW_Humpback_022. In this example sighting #21 was of blue whales; sighting #22 was of humpback whales.

Identifying individuals and matching ID photos

- Digital photos will be examined for unique natural markings and identification of different individuals following methods as described by (Olson, 2010) and Sears et al. (1990). As time allows during the voyage (ideally on a daily basis), photographers will work jointly to identify individual blue whales from the photographs.

- Image software and sketches of dorsal fins on the field data forms will aid in sorting individual whales.
- An identification number will be assigned to each unique individual and recorded in the photo database. A best left and best right photo of an individual will be selected and the image name also recorded in the photo database. Photos will be inter-matched between days.
- Upon return from the voyage, digital photographs of individuals will be entered into the Southern Hemisphere Blue Whale Catalogue (IWC-SORP).

3.6 Roles and responsibilities

The lead observer or duty lead observer will be responsible for:

- reminding all team members to ensure all camera setting are set appropriately and to UTC
- coordinating the activities of their observation team to ensure the collection of photographic data is prioritised when opportunities arise
- training of team members likely to collect photo-identification data
- the consistent recording of Photo-ID data in written datasheets

The data manager will be responsible for:

- Data quality control and integrity, and backing up at least daily.
- Management of and archiving all other associated data streams (i.e. images)

3.7 Personnel rosters

See Sections 12.1 and 12.3.

3.8 Training

The lead observer will provide training prior to departure and during the voyage on:

- techniques for photographing whales for the purposes of individual identification
- Data collection sheets
- Photo-ID database
- Matching images

3.9 Equipment

See Section 13.1 for a list of equipment used photo-identification.

SECTION 4. PROCEDURES TO MEET OBJECTIVE 2 – BIOPSY

4.1 Purpose

Objective 2. To collect photographic data and biopsies for individual identification of blue whales.

Genetic tagging from biopsy samples is a well established method that enables the identification of individuals from genetic markers such as microsatellite or SNPs. This individual identification allows the production of sightings histories required for a mark-recapture approach to estimating abundance. Genetic data can also be used assess population structure.

4.2 Operational and Safety Resources

For specific SOPs and JHA see Section 1.8.

All SOPs and the voyage JHA will be distributed to all personnel prior to the voyage. The documents and associated procedures will be constantly under review and updated during the voyage so the identified risks to personnel are mitigated appropriately.

4.3 Biopsy methods

On sighting a whale and switching to the With Whales mode a decision will be made by the Voyage Leadership team whether to:

- Not biopsy from the ship but only attempt the collection of photo-ID data from the ship
- Biopsy from the ship as well as collection of Photo-ID data
- Launch and biopsy from the RHIB

Biopsy from the ship

Biopsy sampling from large vessels is more efficient if multiple biopsy guns are available for use simultaneously (especially when attempting to sample groups comprising more than a solitary animal). Normal procedure on IDCR/SOWER cruises has been for two Larsen guns (and possibly also a tethered Paxarms to be available).

- The firearm handler must follow the SOP associated with firearm use and the collection of biopsies.
- The firearm handler will only fire from a designated position identified within the associated SOP.
- The biopsy dart will be fired from a Larsen biopsy gun, based on an 9mm Remington Rolling Block rifle, Model 1867. The other biopsy rifle, a modified .22 Paxarms rifle, will primarily be used from the RHIB.
- If using a Larsen gun the dart should **not** be tethered.
- The two Larsen guns should be stationed on each side of the bow.
- All darts should be labelled uniquely for each gun, i.e. darts for one gun labelled with letters and the other gun numbered darts.
- A supply of darts, propelling plugs, ammunition, spare batteries for the sights and a selection of tools available in a small waterproof toolbox.
- The shooters are responsible for loading the darts and gun.
- A photographer should be assigned to document the shooting sequence of each Larsen gun.

- A photographic sequence should include an image of a 'white board' or magnetic numbers indicating the sighting number (Logger ship reference number), image of the dart label prior to loading, images documenting the shooting sequence and typically photo-ID images showing the dart verdict on the whale, dart retrieval and an image of dart with/without sample.
- A dedicated buoy thrower (see Section 12.3) should be responsible for deployment of a marker buoy as close as possible to each dart on the water (in the case of simultaneous firing of both guns only one buoy is normally deployed to minimize buoy retrieval time).
- Biopsy firing positions are marked as GPS waypoints on the ship's navigation system and in Logger to aid return of the ship for dart retrieval.
- After one shooting attempt, the chase may be continued for another shooting (or two) before the ship should return to retrieve the darts and marker buoys.
- Buoys typically consist of two floats attached together with a short line and a weight to aid throwing.
- Darts should be retrieved with long-handled nets (handles 5-6 metres) and buoys with long-handled hooks - a net handle longer than about 7m would be unmanageable. Retrieve from a safe position near the lowest part off of the ship's side.
- During dart retrieval two people should remain on the bow to help detect the darts on the water, and to facilitate approach of the ship; others should man the nets and hooks
- Return towards the dart (marked with a buoy) with the dart on the leeward side of the ship (ships track across the wind) and drive very slowly so the dart (and hopefully also the marker buoy) passes the bow just on the leeward side. A person on the bow should provide clear instructions to the bridge (usually radio or hand signals).
- Several nets should be ready at different stations along the side of the ship. The person on the bow should walk back, track and clearly point the position of the dart to the bridge and keep the net people informed of its whereabouts. If the dart passes on the wrong side (windward side) the ships track will usually drift away and the dart will be out of reach. In this case its easiest to reverse the ship and try another approach.
- The written RHIB datasheet will be used for recording biopsy information (this datasheet can be used for this purpose as well as for the RHIB)
- Sample numbering from the ship will begin at 001 and so start with code: 001_BW_20130212

Biopsy from the RHIB

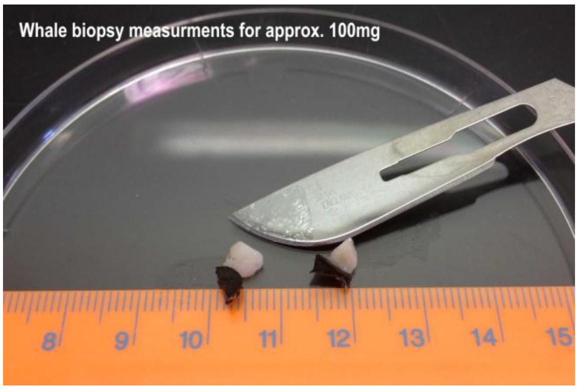
- The firearm handler and the RHIB team must follow the SOP associated with firearm use and the collection of biopsies.
- 'Remora' is a purpose-built 5.8m rigid-hulled inflatable boat that can be launched from the ship weather permitting.
- The RHIB can be used to approach large whales and to within range for a biopsy shot (<25m).
- The biopsy dart will be fired from a modified .22 Paxarms rifle. The other biopsy rifle, the Larsen biopsy gun, based on an 9mm Remington Rolling Block rifle, Model 1867 will primarily be used from the ship.
- The dart will not be tethered.
- The dart and sample will be retrieved with a small net once the whale > 50m away.
- When deploying satellite tags from the RHIB, biopsies will be collected simultaneously.
- The written RHIB datasheet will be used for recording biopsy information (the datasheet can be used for this purpose as well as on the RHIB).
- Sample numbering from Remora will begin at 51 and so start with code: 051_BW_20130212

Archiving samples

- Samples within biopsy darts will initially be placed in a zip lock back labelled with:

  Date
  Time
  Sample number

- Zip lock bags will be stored safely in an insulated box.
- On return to the ship the samples will be processed using [near] sterile equipment and handling procedures. Equipment including darts should be washed thoroughly between samples.
- The samples will be split between vials with the following preservatives
  1. AllProtect (two vials for each individual sampled)
  2. 70% ethanol
- Ensure there is sufficient quantity of preservative to ensure protection of the sample.
- For AllProtect the sample size should not exceed 100mg for 1000ul of preservative. For reference a photograph is provided below of a 100mg samples.



- If the biopsy is sufficiently large then a portion of the sample can be frozen without preservative in the cryoshipper or stored in DMSO at -20°C.
- All vials must be labelled clearly with:

  Date
  Sample number
  Species
  Preservative

- Samples should be stored in a freezer. Freezers should be checked each day.
- If possible two sets of samples should be maintained and stored in separate locations on the ship.
- All vial containers must be labelled clearly and carefully with its contents and that the samples are owned by the AAD.

4.4 Equipment

See Section 13.3.

4.5 Data collection

All biopsy events on the ship should be recorded in Logger and as much associated data as possible.

In addition all biopsy data from the ship **and** the RHIB should be collected on the RHIB Field Datasheet (see Section 11.8).

4.6 Data management

All data recorded on the written RHIB Field Datasheets (see Section 11.8) should be entered into the RHIB & Biopsy Access Database which should be backed-up daily (see Section 11.11). This database should be the definitive database for **all** biopsy sampling whether from the ship or the RHIB.

4.7 Roles and responsibilities

See Section 12.3.

The data manger will be responsible for ensuring all written and electronic datasheets are completed soon after any biopsying activity. They will also ensure that the biopsy sample numbers are consistent between written datasheets, databases and the biopsy vials.

4.8 Training

All team members operating both the tagging gun and biopsy rifle will be required to hold a current firearms licence under the correct categories (A and B for a Tasmanian firearms licence). Completion of firearms safety training is mandatory to successfully receive a firearms licence in Tasmania. In addition, all voyage participants will undergo pre-departure training and at least one member of the boating team will be trained in first-aid.

Practice sessions should be conducted for biopsying from the main vessel to ensure coordination between shooters and their buddies, with the rest of the science team and the crew.

SECTION 5. PROCEDURES TO MEET OBJECTIVE 3 – ACOUSTICS AND BEHAVIOUR

5.1 Purpose

Objective 3. Linking blue whale calls to their behaviour and environment

Antarctic blue whales make loud and repetitive vocalisations, but the purpose and context of these sounds is not well understood. There has been preliminary investigation of the behavioural context of North Pacific blue whale sounds (Oleson et al., 2007) but very limited data collected on the behavioural context of Antarctic blue whales. The purpose of this objective is to collect data that can be used to investigate correlations among blue whale vocalisations, observations of behaviour, and, if possible, individual characteristics of the whales. Observations of unbiased whale behavioural can only be collected when initially approaching a whale or group of whales that have been vocalising. Any associations among whale vocalisations, behaviour, and genetics will assist is future passive acoustic survey design and also feed into the SORP Acoustic Trends project.

5.2 Operational and Safety Resources

For specific SOPs and JHA see Section 1.8.

All SOPs and the voyage JHA will be distributed to all personnel prior to the voyage. The documents and associated procedures will be constantly under review and updated during the voyage so the identified risks to personnel are mitigated appropriately.

5.3 Methods

- Upon approaching within 1-2km of a previously sighted blue whale a nominated behavioural observer from the observation team will record the behaviour of the whale(s) using a digital video recorder.
- The internal clock of the dictation recorder will be synchronised with the GPS at the beginning of the voyage, and any offset will be noted daily so that observations can be synchronised with blue whale sounds as well as photographs and any biopsy sampling.
- The behavioural observer will follow a cue card to ensure that all required fields are addressed – see Section 11.9 for required fields.
- The behavioural observer will record whale behaviour throughout the entire encounter with priority given to the first 30 minutes of the encounter.
- As any approach or interactions with whales will affect (i.e, bias) their behaviour, observations of whale behaviour will terminate upon:

  1) Main vessel moving towards group to for better photographs and/or biopsy sampling;
  2) Launching small boats to approach whales for photographs, biopsy or satellite tagging; or
  3) When main vessel retreats from whales as no further photograph/biopsy is advised.

5.4 Roles and responsibilities

The Lead Observer is responsible for:

- Ensuring that a behavioural observer has been nominated during each roster session to record behavioural observations.
- Regularly checks that the observing protocol is being followed.

- Ensures cheat/cue sheets are present at all observing stations.

The observer is responsible for:

- Describing blue whale behaviours and dictating observations onto digital video recorder.
- Transcribing the data into electronic Whale Vocalisations and Behaviour Datasheet.

The Data Manager is responsible for:

- Synchronising the clock of the audio recorder and cameras with GPS.
- Ensuring proper function of dictation recorder and backup of dictation audio at least daily, but preferably after each encounter.
- Ensuring the dictation has been transcribed into the Whale Vocalisations and Behaviour Datasheet.

5.5 Equipment

See Section 13.4.

5.6 Data collection

See Section 11.9 for required fields.

5.7 Data management

Data from digital video recorders will be backed up and kept together with the passive acoustic tracking data and observations/line transect data – see Section 11.11.

Dictated behavioural data will be transcribed either during the voyage, during times of bad weather, or after the voyage, as time permits. Behavioural data will be linked to the encounter number of the observation and the timestamps will link the behavioural data to passive acoustic recordings of whale vocalisations.

5.8 Personnel rosters

See Section 12.3.

5.9 Training

Training in observer protocols will occur prior to departure with further practice and refinement on the vessel when underway. Lead observer and RL will conduct observer training.

SECTION 6. PROCEDURES TO MEET OBJECTIVE 4 – DISTANCE SAMPLING

6.1 Purpose

Objective 4. Collect distance sampling data for a survey-region level abundance estimate of Antarctic blue whales and other cetacean species

By collecting distance data from observations of various cetacean species during the Antarctic blue whale voyage, sufficient sightings may accrue to generate regional abundance estimates. This will allow comparison with sighting rates recorded by IWC-IDCR/SOWER voyages which operated in a similar area around a decade ago.

When observing objects along a track line, the chance you will detect an object decreases the further away it is. If trying to estimate the total number of such objects in some area (i.e., the abundance), one needs to be able to consider not only the number of objects detected, by also an estimate of the number of objects missed. Distance sampling is a method where the distribution of distances from the track line, to the sighting is used to estimate the number of objects missed. In distance sampling, special emphasis is placed on accurate estimation of distances, species and group size, by observers.

Please note, this objective is essentially overlaps almost completely with observing component of Objective 1. The main difference in Objective 4 is the emphasis on obtaining accurate distance and angles to the sightings, and more careful recording of which observers are on effort, and which are making sightings, etc.

6.2 Operational and Safety Resources

For specific SOPs and JHA see Section 1.8.

All SOPs and the voyage JHA will be distributed to all personnel prior to the voyage. The documents and associated procedures will be constantly under review and updated during the voyage so the identified risks to personnel are mitigated appropriately.

6.3 DRAFT Protocol for Logger data entry system for visual observations

The 'Logger' data entry system was developed by the International Fund for Animal Welfare (IFAW) and is a flexible system to record information during a voyage. This system is the primary data entry system for the voyage and all events will be recorded in Logger's database.

1) Set up at start of voyage

Responsible: RL, PO & VA-G

1.1 Measure platform heights (Flying bridge and Bridge) plus eye heights for observers standing and sitting. Ask skipper about likely changes in vessel waterline throughout the cruise due to fuel load. Take photos of waterline of vessel at start and end of cruise if possible.
1.2 Print out tables of reticle to distance conversions for ease of use on Flying Bridge and Bridge
1.3 Investigate the positioning of an overhead video camera for bearing measurement (will depend on what can be mounted above the observers and power supplies).
1.4 Logger computer on the bridge will need NMEA feed from ship's system. Heading from GPS sensors (rather than based on movement) will be particularly important for this

project because there is a need to measure bearings when the vessel may not be moving. Other useful data that may be available through the NMEA feed include wind speed, wind direction, depth and sea surface temperature. If these are not available through the ship's system then they will be included on Logger forms to be entered manually.

1.5 If mains power available to Flying Bridge then power supplies for the video cameras will need to be made up so that the transformers can remain in a protected location.

1.6 Communication between Flying Bridge and Bridge is likely to be the issue that requires most practice and training. Commentary protocols for reporting sighting data in the same order that it appears on the Logger forms have been developed and these will need to be learnt.

2. Daily checks

Responsible: PO & VA-G

2.1 The time of all events is used to link the data together and so accurate times are the most critical data item. The times on all computers, SLR and video cameras, and any wrist watches observers might need to use, should be synchronised with the GPS each day.

2.2 Charge Batteries? (depending on availability of mains power)

2.3 Video cameras will need to be set up in preparation for tracking (see video tracking section).

2.4 Check and validate the day's data (specialist software should be available to help with this)

2.5 Backup Logger database with separate copy for each day

2.6 Download and backup video cameras/SLR camera/bearing cameras

3. Training and experiments in observer distance estimation

Responsible: RL & PO

Whilst distance experiments have their limitations there will inevitably be some reliance on distance estimates by naked eye. Dedicated distance experiments are also very time consuming. However, training over a range of conditions can only improve on distance estimates. The proposal is to use the regular deployment of the RIB for distance training wherever possible. The RIB will have a data logging GPS unit so that all observers need to do is to record the time and their distance estimate to the RIB during training sessions. These can then be compared at a later time to the measured distances to give feedback to the observers. If extra personnel are available it may also be possible to give some feedback in real time using the ship's radar. There may be limitations on how far the RIB can go from the ship so some distance experiments at further distances may be attempted using icebergs.

These distance experiments will be conducted with naked eye, reticle binoculars and video systems. These sessions will give training in video tracking as well as distance estimation for any observers who may be using the video tracking system.

4. Standard line transect searching protocol

Responsible: Acting lead observer and data recorder

The standard searching protocol (Logger effort code Visual Transect – VT or Bridge Only - BO) will be conducted whenever the vessel is on some form of random transect. A flowchart for the different modes of visual effort and changes between these is shown in Figure 1.

1.1 One observer searching each side of the vessel to 90 degrees from the track line and one data recorder who can also watch . In good conditions a minimum of two observers will watch from the Flying Bridge. In less good conditions (>Sea State 5 or rain), observers will watch from the bridge. The data recorder will always be on the bridge.

1.2 During conditions when two observers are on the Flying Bridge (VT effort), these are treated as the primary observers. One observer will search towards the horizon with binoculars while the second observer searches with naked eye. In poor visibility (<2nm) both observers will search with naked eye. Sightings by anyone else (either on the Flying Bridge or the Bridge) should not be relayed to these observers. All sightings made from Bridge are relayed directly to the data recorder. If extra people on the Flying Bridge see things then these can only be called once passed abeam unless they are possible blue whales. If the sighting is still on the surface when it comes abeam then this should be the distance that is recorded, otherwise the angle and distance of the last surfacing seen closest to the beam should be recorded (these sightings are all entered as incidental sightings). Additional observers can call resightings of sightings which have already been reported by the primary observers and may particularly be able to help with estimates of group size. Group size estimates are entered on the original sighting form and so the data recorder should keep the tab open until it is clear there will be no more resightings i.e. it is likely the sighting has passed abeam or sperm whale fluke indicating a long dive. The primary observers will be responsible for deciding whether a sighting is a resighting. The primary observers should maintain a search for new animals once a sighting has reported and identified; calling resightings is a secondary priority although it is important to spend sufficient time following a sighting to get a group size estimate

1.3 During conditions when all observations are made from the Bridge (BO effort), all observations are called regardless of who made them. Under these circumstances, everybody on the bridge functions as an observer team. This is because it is likely to be impracticable to keep the designated observers independent of other observations on the bridge. The data recorder and observers together will need to judge whether something is a sighting or resighting. Sightings and resightings are stored within separate tables in the database. Each table has a field which can be edited at the data validation stage if sightings or resightings have been incorrectly assigned. This issue should be flagged at the time with a Logger comment.

1.4 The data recorder should update the ‘Effort’ tab whenever anything changes and ‘Environment’ tab at least once an hour or whenever anything changes (Logger will prompt when Environment overdue).

1.5 A sightings form is opened in Logger by clicking on the appropriate button on the Sightings Buttons tab. The data recorder should have this tab open or use the hot keys

1) Ctrl+F5 = Flying BridgeSighting Ctrl+F6 = Flying BridgeReSighting
2) Ctrl+F7 = Bridge Sighting Ctrl+F8 = Bridge ReSighting
3) Ctrl+F9 = Incidental Sighting (All sightings that are not made from the Flying Bridge or Bridge or are made from the Flying Bridge by other than the two nominated observers in VT effort)

1.6 Observers should provide reticle readings to all sightings wherever possible even if they have been searching with naked eye. Reticles on Fujion binoculars, one reticle is large mark to large mark, smaller marks are 0.5.

1.7 Angles should be recorded relative to the ship’s heading on a 0-359^o scale (i.e. 330 is 30^o to port)

1.8 Whale headings should be recorded relative to the ship’s heading. 0 is directly away, 90 is heading from port to starboard, 180 directly towards.

1.9 Observers on the Flying Bridge keep a flip scoreboard showing the number for the next sighting. This is updated after each sighting. Observers should check with data recorder after any busy periods to confirm that sighting numbers match with Logger.

1.10 If a definite blue whale is seen (i.e. enough body has been seen to be certain that it is a blue) while on transect and it has not been previously detected acoustically then switch effort to 'Visual Bearing according to protocol from 8.1(d) onwards.

1.11 If a 'possible' blue whale is seen (and it is likely that most blue whales will be seen as blows at distances at which they cannot be positively identified straight away) then the vessel may wish to close on the sighting to identify species. The data recorder will be responsible for communicating any requests to change course to the watch officer. Change Logger effort to 'Visual Bearing' until sighting is either identified as blue whale or not. If blue whale then follow from 7.1(d) onwards. If not blue whale then resume 'Visual Transect' effort as soon as the vessel is back on a steady course and speed.

5. Number of animals

Number of animals as reported by the observer is the number of animals within a clearly discrete group. For large baleen whales, to be classified as a group, animals should be surfacing synchronously or near synchronously in close proximity to each other (within 500m). If unsure whether to classify animals as a group then it is always better to record them as separate sightings unless there is so much going on that it is not possible to report the information fast enough.

6. Co-ordination with acoustics team

While on transects, the acousticians will be regularly deploying sonobuoys. They will call the Bridge to request permission and then inform when deployed. The data recorder should enter the deployment on the Sonobuoy tab in Logger. The acoustics team will also be recording the locations of sonobuoys but it can be useful for the visual team to be able to switch to plot these in map view as well. There is no change in visual survey protocol unless a blue whale is heard.
If a blue whale is heard then the acousticians may request a change in heading. At this point the visual effort changes to "Acoustic Bearing – AB" and protocol in 7.1 is followed.

7. Radio Commentaries

For radio communication from Flying Bridge to data recorder
Obs: "SIGHTING"

Data recorder: Presses sighting button in Logger to open up sighting form; "GO AHEAD WITH DETAILS"

Obs: SIGHTING AT [X] RETICLES or DISTANCE is [X] metres

Obs: ANGLE is [X] degrees

Obs: SPECIES is [X- species code includes confidence in species id]

Data recorder repeat back: SPECIES [X] AT [X] RETICLES, ANGLE [X] DEGREES

Obs: SIGHTING CUE [X], HEADING [X] DEGREES

Obs: NUMBER OF ANIMALS is [LOW, BEST, HIGH]

Low = number of animals the observer was sure were present
Best = best estimate
High = observer's estimate of the maximum number present

Data recorder repeat back: CUE [X], BEST [X], SIGHTING NUMBER IS [X]

Once this essential information has been exchanged then observer can relay additional information (e.g. Group Behaviour, Pod Compaction, Surface Synchronicity, Pod Dynamics) as time allows and resightings as they are seen.
Obs: RESIGHTING AT [X] RETICLES or DISTANCE is [X] metres

Obs: ANGLE is [X] degrees

Obs: RESIGHTING OF [X]WITH CONFIDENCE [Definite/Probable/Possible]

Obs: Sets flip chart to sighting number for next sighting

8. Estimating the number of whales within aggregations

Once a blue whale has been detected acoustically and the vessel has departed from the track line then any visual data cannot be used for standard line transect analysis for blue whales. However, this is equivalent to a closing mode survey – though in this survey there will be no 'return to ttrackline'. If the number of animals in the group or aggregation can be estimated then this could be used for an overall density estimate (provided some form of detection function can be established for the acoustics). The problem for estimating the number of animals within an aggregation is that the whales are likely to be dispersed over a wide area and the track of the vessel will be determined by the need to obtain photo-id and biopsy of individual whales.

The aim of this section of the protocol is to provide a way that the size of the aggregation may be estimated that does not interfere in any way with the primary objective of approaching individual whales. For each aggregation, the data required are the extent (area) of the aggregation, the average density and the 'centre'. Aggregations may be dispersed over a wide area with potentially many clusters of animals.

8.1 Stages - Departure from standard searching

Vessel departs from pre-determined acoustic track line after an acoustic detection to follow an acoustic bearing.

a) Change effort in Logger to "Acoustic Bearing". Data recorder informs observers of change in effort status. An additional observer who is on stand-by prepares to go up to Flying Bridge (to make a team of three on Flying Bridge).
b) Two observers on Flying Bridge search 90^{o} either side of vessel for blows. The aim is to find whales and so any additional observers on the Flying Bridge also call sightings.
c) When possible blue whale is seen, assess conditions. If not suitable for close approaches or small boat operations then follow protocol in 8.3 otherwise continue from 8.2d below. There may be circumstances where the acousticians want to carry out experiments and will need to direct the ship. This will be decided by the cruise leader on a case by case basis. For these experiments visual observers follow protocol in 8.
d) Sighting information is relayed to data recorder. Third, stand-by observer, goes up to Flying Bridge. The observer jobs in this effort on Flying Bridge are
    (i) One observer, the 'Searcher' searches all round (360^{o}) for other blows and records locations using either the SLR tracking system or reticles and angles; carries out opportunistic photo-id; relays any information from the tracker observer to data recorder
    (ii) One observer, the 'Tracker' starts video tracking using video camera system
    (iii) One observer, the 'Driver' directs the boat in liaison with the helm.
e) If weather suitable for small boat operations, change effort in Logger to "With whales" and ship track is then determined by close approaches. If weather too poor for small boat then change effort in Logger to "Surveying Aggregation". Ship then follows designed transect pattern within the aggregation following procedures in 8.3.
f) Video tracking observer remains tracking first whale until either lost or cannot distinguish with other whales to obtain as long a track as possible of small-scale movement and surfacing rates of a single individual. Searching observer tries to record the surfacing locations of all individuals seen using SLR system or reticle binoculars to obtain times, distances and relative bearings to the vessel. Searching observer is

responsible for relaying summary information to data recorder. During small boat operations or close approaches by ship the Driver takes responsibility for directing both the ship and directing/communicating with the small boat. Tracker continues to try and track any possible individual whales. Searcher continues to record all sightings by relaying these to the data recorder and using SLR system plus opportunistic photo-id. It is unlikely that it will be possible to do full cue counting so the aim is to get a location for each individual whale seen. If as many locations are recorded as possible by the Searcher, this gives the best chance of being able to estimate the number of individuals. It is likely that it will not be possible to be certain about distinguishing between sightings and resightings. This should not be a problem for analysis as long as locations are recorded accurately.

g) It is likely that the ship will follow the general movement of the aggregation and gradually end up within the highest density area. If more distant animals are sighted these can be approached by ship to shift the focus of individual approaches to a smaller group, so ship can move from patch to patch.
h) If biopsy is being attempted from the ship then there may be safety considerations related to the locations of the observers depending on where the biopsy gunner is shooting from. Observers may need to stay inside the bridge in some situations.

8.2 Stage - Decision to stop close approaches

The decision to stop close approaches may occur for a number of reasons. If other whales have been sighted then this counts as staying within an aggregation so protocol as for 8.1d onwards applies.

a) It is believed that all individuals that have been sighted have been approached for biopsy/photo-id
b) Weather too poor for small boat operations but still allows observations
c) Darkness or weather too poor to observe

In the case of (a) then a new transect course will be chosen based on the best hope of finding another group of blue whales, i.e., tracking along the sea ice edge, or along the shelf-break. The effort reverts to “Visual Transect - VT”.

In the case of (b) there is scope for designing transects to establish the extent and density within the aggregation while maintaining contact with whales and waiting for the weather to improve. If the weather is not expected to improve then the ship may just leave the area to search for whales in better conditions. Follow procedures in 8.3.

In the case of (c) then there is nothing more to be done.

8.3 Stage - Surveying aggregations.

The aim is to estimate the extent and numbers of whales within an aggregation. This survey mode will only be undertaken when it is not possible to approach individuals for photo-id or biopsy either with ship or the small boat.

a) If waiting for the weather to improve then a set of transects will be designed to allow the aggregation to be surveyed while returning to the start point where a whale was last seen. This might be achieved by heading off on a transect at 60^o to the course at which the aggregation had been approached. The vessel would survey for 3nm then turn 120^o to return across the original course line for 6nm (the exact length of transects may be much longer based on the available information and be decided at the time). If any whales are encountered on these transects then the zig-zag pattern is continued. If no whales are encountered then at the end of the second transect the vessel turns to head on the reciprocal of the original approach course for 3nm then back towards the last sighting (this would provide 15nm of track or about 1.5 hours of survey from departing from the last sighting to arriving back in the location where it had last been seen). Although most adaptive survey strategies do not return to the point of the last sighting, in this case the main aim is to get photo-id and biopsy data and so the objective is not to go too far away from known whale locations.

b) If the weather is not expected to improve then the ship will probably wish to leave the area. If time is available then the survey design in 8.3a could be followed (but without returning to the original sighting location). If there is more limited time then the original approach heading should be followed for as long as practicable (e.g. 3nm after the last blue whale sighting) before turning to resume an acoustic transect or head to an area based on other information.

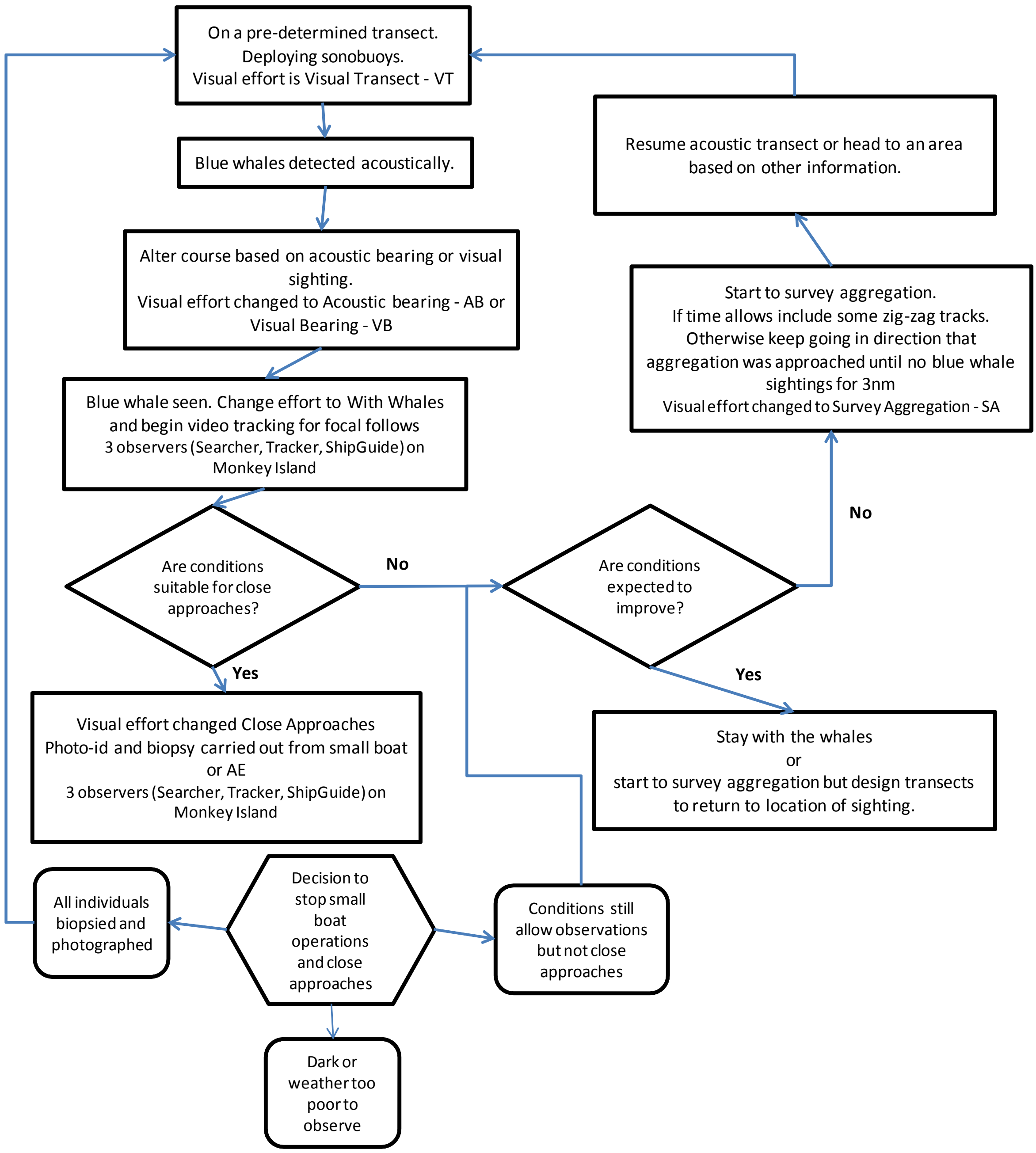
9. Video tracking

There are two options for tracking animals using photogrammetry, either with an SLR or a video camera. Both methods rely on measuring distance from angle of dip from the horizon and bearings from reference marks on the deck or a fixed camera looking down at the observer.

When with whales, the data from the Tracker is intended to provide a combination of accurate locations (distances are measured from the video and bearings relative to the vessel from a digital still camera) and behavioural observations including dive times, blow rates and changes in heading. These will be limited to single animals or tight groups. The Tracker should give a comprehensive commentary on the video sound track including all blows, heading of the whale and fluke ups. These data may be useful in relating behaviour and small scale movements to vocal activity and persistence of aggregations. It is expected that the Tracker will use a combined video and binocular mounted on a monopod with a downward pointing digital still camera. The Tracker should use a separate microphone clipped to their collar out of the wind. For each surfacing the Tracker presses the shutter button on the still camera to obtain a bearing from reference marks on the deck.

The role of the Searcher is to record the locations of all whales using either the video tracking system or an SLR camera combined with still images to measure bearings. The locations of the whales will be used to establish whether sightings are of the same individuals in situations where it is difficult for observer's to be sure which are new sightings and which are resightings. It may also be useful for the acoustic analysis to have accurate locations of all whales that are visible. This is not intended as a cue counting exercise and so the Searcher does not need to record all the blows of all the individuals, but should attempt to do this if it is possible. If the Searcher is scanning with the naked eye then the SLR camera combined with a downward pointing mini video (Veho MUVI) provides a good system. The Searcher then just has to take an picture of each new whale location. The mini video cannot use an external microphone but is positioned just in front of the observer's mouth when taking a picture and should give an adequate commentary except in very windy conditions.

Section 6.3 Figure 1. Flowchart for changes in visual effort protocols



6.4 Roles and responsibilities

See above and Section 12.3.

6.5 Equipment

See Section 13.1.

6.6 Data collection

See above and Sections 11.4.

6.7 Data management

See Sections 11.4 and 11.11.

6.8 Personnel rosters

See Sections 12.1 and 12.3.

6.9 Training

Training in observer protocols will occur prior to departure with further practice and refinement on the vessel when underway. Lead observer and RL will conduct observer training.

SECTION 7. PROCEDURES TO MEET OBJECTIVE 5 – SATELLITE TAGGING

7.1 Purpose

Objective 5. Deploy satellite tags to describe the movement and behaviour of blue whales

Antarctic blue whale movement has been described using static location information such as that derived from the retrieval of a discovery-tagged whale, photo identification (see Branch et al., 2007) or acoustic data (Stafford et al. 2004). These techniques however are unable to provide a continuous record of actual movements instead inferring movement from two (or more) known locations at two (or more) separate points in time. Actual movements of the whale between these points in time are not known. As such, detailed information such as large scale migratory movement between breeding and feeding grounds or even fine scale movement within a feeding ground remain poorly understood.

7.2 Operational and Safety Resources

For specific SOPs and JHA see Section 1.8.

All SOPs and the voyage JHA will be distributed to all personnel prior to the voyage. The documents and associated procedures will be constantly under review and updated during the voyage so the identified risks to personnel are mitigated appropriately.

7.3 Methods

- Up to 40 satellite tags employing a fixed anchor will be deployed on Antarctic blue whales from the RHIB Remora.
- These satellite tags manufactured by Wildlife Computers (Redmond, Washington, USA) and Sirtrack Ltd N.Z. contain the Spot 5 transmitter and implant up to a maximum of 290mm into the skin, blubber, interfacial layers and outer muscle mass of the whale, generally just forward and to the left or right side of the dorsal fin. Retention of the tag is maintained through two actively sprung plates, and a circle of passively deployed 'petals.' All external components of the tag are built from stainless steel and the tags are surgically sterilised prior to deployment.
- Remora will be deployed after agreement from the Voyage Management Team following the sighting of an Antarctic blue whale resting or feeding, weather permitting.
- The water-craft will approach slowly and the approach will be terminated if the whale actively avoids the boat. Once in position, a single rapid approach will be made whilst the whale is surfacing and the tag will be deployed from the bowsprit within a range of 3-8m.
- If the tag is not deployed during this fast approach, further approaches will only be attempted if the whale continues to be unconcerned by the movements of the boat.
- Avoidance behaviour by the whale will be used to signal the animals' level of concern and will determine whether the attempt will be terminated.
- Tags will be deployed using a compressed air gun (modified ARTS, Restech) set at a pressure of 7.5 - 10 bar. Retention teeth on a purpose-designed projectile carrier grip a metal ring fitted to the end of the tag allowing the tag to be fired from the air gun. When the tag makes contact with a whale, the rapid deceleration of the tag and the projectile carrier withdraws the retention teeth releasing the projectile carrier. The metal ring then falls off in time to reduce the drag of the tag. Once the tag is immersed in salt water, the salt water switch activates and the tag will begin to transmit locations via the Argos satellite system.
- Up to 6 satellite tags will be deployed opportunistically on minke whales in the same manner if time permits although this is a low priority. These tags will differ to those deployed on

Antarctic blue whales being shorter and incorporating new tagging technology that processes data collected by the salt water switch to report on surfacing and dive behaviour via the Argos satellite system.

- Each tagging attempt and successful deployment will be photographed and filmed. Biopsy and photo identification of the target animal will occur during the tagging procedure. Time of initial sighting, behaviour pre-, during and post-tagging plus environmental conditions during the tagging process will be recorded.
- Data on deployment will be recorded using the written RHIB Field Datasheet – See Section 11.8.
- The RHIB Datasheet will be transcribed to the Biopsy and Tagging Database soon after the retrieval of the RHIB.

7.4 Data collection

Deployment information will be recorded on the RHIB Field Datasheet (Section 11.8) and transcribed into the Biopsy and Tagging Database.

7.5 Data management

See Section 11.11.

Satellite tag location data will be transmitted via the Argos satellite system under the AMMC's Argos program number 13440. The Australian Antarctic Data Centre currently downloads and archives all Argos data generated by satellite tags from this program. This data will be forwarded to the ship to produce daily summaries, assess tag performance and provide an additional archive of the data.

7.6 Roles and responsibilities

See Section 12.3.

The RHIB Data Collector is responsible for:

- The completion of a RHIB Field Datasheet for each deployment

The Data Manager is responsible for:

- Ensuring the RHIB Field Datasheet has been completed correctly and transcribed to the Biopsy and Tagging Database.
- Responsible for recording data encompassing all aspects of the tagging procedure – time of sighting, behaviour pre-, during and post-tagging, group size, environmental conditions, incidental observations.

7.7 Equipment

See Section 13.5.

7.8 Personnel rosters

The RHIB team will be available when required.

7.9 Training

Training in tag set-up and RHIB-based deployment will be given prior to the voyage.

SECTION 8. PROCEDURES TO MEET OBJECTIVE 6 – KRILL COLLECTION

8.1 Purpose

Objective 6. Collect Antarctic krill (*Euphausia superba*) for krill ecological genomics study

The krill collected will be used for genetic analysis at the Australian Antarctic Division (part of Australian Antarctic Science Program project 4015: Krill ecological genomics). This project is looking at krill circumpolar population genetic structure and is currently lacking samples from the region to be surveyed during the Antarctic Blue Whale Voyage. Sampling for adult krill would occur opportunistically during the voyage near the ice edge between 150-175E and krill samples stored in ethanol.

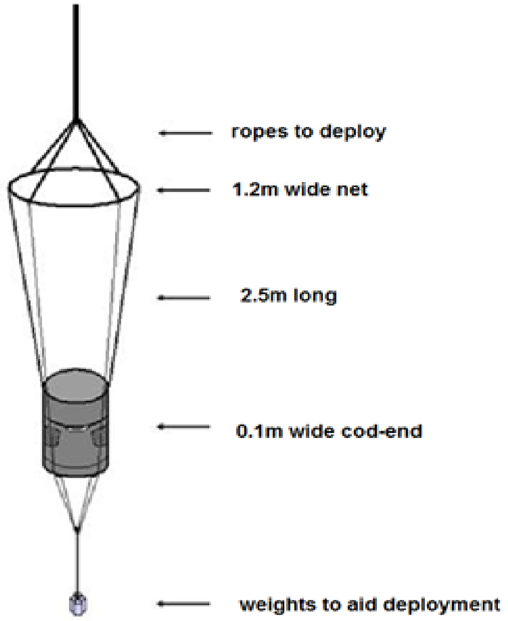
8.2 Operational and Safety Resources

For specific SOPs and JHA see Section 1.8.

All SOPs and the voyage JHA will be distributed to all personnel prior to the voyage. The documents and associated procedures will be constantly under review and updated during the voyage so the identified risks to personnel are mitigated appropriately.

8.3 Methods

- Sampling will involve either manual deployment of a plankton net over the side of the vessel using a rope, or briefly trawling a plankton net behind the vessel.
- Manual deployment would occur opportunistically during the day in good weather conditions if krill are observed near the surface of the water, or in the vicinity of feeding sea birds. This would involve vertically lowering the net from a stationary vessel to a depth of roughly 5- 10 meters and slowly retrieving the net. Alternately the net could be deployed by trawling behind the fishing vessel.
- For trawling, sampling could occur if krill are visible, or otherwise should occur at night within 100 - 200m of the ice edge at 5-10 m depth. Trawling at a slow speed of 1-2 knots is required to prevent krill being crushed in net and 15 minutes should be enough time to catch required samples if krill are present in the area. For trawl deployment a wire line (or rope) from a winch (or capstan) on the vessel will be attached to the net and lowered into the water behind the vessel; the net should sink to required depth at a speed of 1-2 knots. The trawl deployment winch will be operated by trained members of the ships' crew.
- The net to be used for both purposes is conical plankton net (1.2 meter wide opening, 2.5 m long). It has been recently used for krill collection (SIPEX; November 2012) and is fitted with a clamped cod end suitable for krill collection. Up to 50 whole krill from each sampling will be preserved in 95% ethanol in the provided container (maximum 100 krill total).



8.4 Roles and responsibilities

- Deputy Voyage Leader and Talley's crew will deploy net
- DVL will process samples on board

8.5 Data collection

Responsible: DVL

- Date and location of collections are to be recorded on sample labels and in a simple for – Krill Sampling form within Logger on the Logger laptop.

See Section 13.7 for sampling equipment.

8.6 Data management

Responsible: DVL

- Storage, handling and later transport of the samples will be conducted by the DVL
- Back up of the Krill Sampling data on the Logger laptop will be conducted by Data Managers after each sampling session
- The storage location and sampling information will be communicated to the Data Managers
- Samples can be stored at room temperature on the ship
- The samples will finally be stored in the genetic laboratory at the Australian Antarctic Division and resulting genetic data will be part of Australian Antarctic Science Program project 4015

8.8 Personnel rosters

Opportunistic sampling - rosters not required.

8.9 Training

No specific training required.

SECTION 9. PROCEDURES TO MEET OBJECTIVE 7 – ACOUSTIC METHODS

9.1 Purpose

Objective 7. Testing of kite-antenna for improved sonobuoy radio reception

Present methods for real-time acoustic tracking of blue whales are very expensive in terms of equipment, personnel, and ship time. Real-time acoustic tracking presently depends on DIFAR sonobuoys, which can be expensive and have limited availability to civilian scientists. Improvements to the acoustic tracking methods may be tested on this voyage in parallel to normal acoustic tracking operations, but only if there is sufficient time, personnel, and resources available. Thus it is expected that only a small portion of time will be devoted to this objective.

During this voyage, improvements to the existing real-time tracking system will focus on increasing the VHF reception range for each sonobuoy. Improving the VHF reception range will allow us to monitor each sonobuoy for a longer amount of time, and thus to improve efficiency by deploying fewer sonobuoys overall. Improvements to the VHF reception range will make use of an antenna that is attached to a kite. Initial tests are likely to take place during the transit to the field site, and other times when it is likely that the vessel will maintain a relatively stable course with respect to the wind. If the initial tests are successful, the kite-antenna may also be used throughout the voyage as conditions and rosters allow.

9.2 Operational and Safety Resources

For specific SOPs and JHA see Section 1.8.

All SOPs and the voyage JHA will be distributed to all personnel prior to the voyage. The documents and associated procedures will be constantly under review and updated during the voyage so the identified risks to personnel are mitigated appropriately.

9.3 Methods

Deployment and retrieval

- VHF reception range of sonobuoys will be increased by using a small (<2 m) flow-form kite to place a VHF antenna as high as practical (up to 100 m) in order to increase the VHF radio horizon.
- The kite will only be operated during favourable wind and weather conditions.
- Favourable weather conditions are an apparent wind speed between 10 and 40 knots, and a wind direction that will keep the kite aloft astern of the vessel and well clear of any potential entanglements.
- The kite will only be flown during modes of operation that maintain a relatively steady course with respect to the wind (eg. Visual Transect, Acoustic Tracking and Acoustics Only modes).
- The kite will be flown from the rear platform above the trawl-deck in accordance with standard operating procedures for deck access.
- During all operation, the kite reel will be attached to the railing or deck away from potential entanglements. In addition to the reel, the kite line will be independently secured to the deck via a double pleat.
- The kite will be flown using dedicated high-strength (200 kg test) line, but this line will have a breakaway clip that will release the kite should the line tension exceed 100 kg (for instance if the kite lands in the sea).

- The kite tether line will have ribbons attached in an effort to mitigate bird strike
- The kite will be launched and recovered by either two or three people so that everyone may maintain 3 points of contact at all times.
- Launch is achieved by lifting the kite into the wind and paying out enough line (eg 5 - 15 m) so that the kite will be clear of any turbulent zones behind the vessel.
- Recovery is achieved by winding the kite line in. When the kite is within reach, the kite is collapsed simply by grabbing the upper wing. During launch and recovery care must be taken to ensure that the kite tails do not snag.

Kite payloads

- The kite may contain two different payloads.
- Most of the time the payload will be a VHF antenna and masthead amplifier and lightweight coaxial cable that returns via the kite line to the ship. The coaxial cable will be attached to the kite line at roughly 6 m intervals using a lightweight clip (clothes pin/elastic band). NOTE: The coaxial cable will be not be used to fly the kite, and will at no point be under tension.
- The second payload, used less often will be a small digital camera for aerial photography or videography. Coaxial cable will not be used with the camera payload.
- Kite payloads will be attached only after a test flight indicates that conditions are suitable.
- Payloads will be attached only after the kite has been launched and is flying stable (ie. above any turbulent zones directly behind the vessel. NOTE: Attachment of the payload does not require full recovery of the kite. Upon attachment, the kite will be allowed to resume normal flight at desired height.

Acoustic data delivery

- Audio from the VHF antenna will be received on the ship and processed as described in Objective 1 - Passive acoustic tracking.
- Audio data from the developmental systems will be handled in the same way as that of the real-time tracking system (see Objective 1, Section 3– Subheading: Massive Acoustics).
- At first, data from kite-antenna will be compared to data from the original fixed VHF receiving system. If the kite-antenna works and extends the working distance of the sonobuoys then the kite will be used throughout the voyage.

9.4 Roles and responsibilities

The Lead Acoustician will be responsible for:

- Overseeing and managing all aspects of training and initially deploying and retrieving kite-antenna.
- Management of data collection, storage, and analysis.

The duty Acoustician and other science personnel may be required to:

- Deploy and retrieving kite-antenna once established protocols have been developed.

9.5 Equipment

See Section 13.5.

9.6 Data collection

Data collection will follow that for other passive acoustic data – see Sections 2.6, 11.5 to 11.7.

9.7 Data management

- See Sections 2.6 and 11.1.

9.8 Personnel rosters

See Section 12.2 – Acousticians roster.

9.9 Training

- Training in deployment, recovery, and flight of the kite will be conducted by the lead acoustician.
- PPE will include gloves for handling line under tension and a knife to quickly release the kite.

SECTION 10. PROCEDURES TO MEET OBJECTIVE 8 – HUMPBACK BIOPSIES

10.1 Purpose

Objective 8. Evaluate the body condition of humpback whales from biopsy samples

Collection of shallow biopsies from humpback whales (Megaptera novaeangliae) for collaborative research project with Griffith University (GU) entitled "Development of a Non-lethal Method for the Evaluation of Nutritional Condition in Humpback Whales (Megaptera novaeangliae); Facilitating Chemical and Environmental Risk Assessment".

This project will evaluate and apply a novel biochemical marker for the assessment of nutritional condition in humpback whales (HWs). Findings will be applied to research questions concerning, a) elevated CHEMICAL RISK associated with a migratory life history and b) The role of NUTRITIONAL STRESS as a co-factor in rising HW stranding events observed in some southern hemisphere populations.

This research will be conducted in parallel with ongoing toxicokinetic modeling and risk-assessment projects within the research team and inherently draws upon close collaborations between HW researchers, thus representing a cost-effective strategy for advancing our understanding of the species and broadly disseminating outcomes and findings.

10.2 Operational and Safety Resources

For specific SOPs and JHA see Section 1.8.

All SOPs and the voyage JHA will be distributed to all personnel prior to the voyage. The documents and associated procedures will be constantly under review and updated during the voyage so the identified risks to personnel are mitigated appropriately.

10.3 Methods

Collection

- When time allows use the Larsen biopsy gun to collect a biopsy of ~0.8 cm diameter x 2-4 cm length; otherwise use Paxarm rifles with tethered darts.
- Whilst handling the biopsy dart/sample always wear nitrile gloves and only handle the biopsy sample with pre-cleaned/solvent-rinsed tweezers.
- If sampling conditions are rough, rest the dart on foil as a "clean" surface during handling.
- Aim for sample storage within 15 minutes of collection.
- Record sample number and any sampling notes on the observation sheets provided.

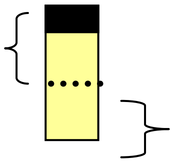
Sample Storage - Main Voyage Vessel

- Record Label an empty cryo-tube with the appropriate sample number. Place sample in cryotube and snap freeze/store immediately in the cryoshipper.
- Label each sample sequentially in the following format: 001_HBKW_20130213

Sample Storage - Sampling from RHIB

- If immediate snap freezing is not possible, and a biopsy core of > 2cm in length is obtained, the biopsy should be divided as follows:

<u>POP/DNA fraction</u>
Place on ice and freeze @ -20°C onboard vessel



<u>Protein fraction</u>
Store in RNA-Later solution, refrigerate overnight and place in cryoshipper.

- Use pre- cleaned/solvent rinsed, tweezers and scissors, divide the sample in two so that each section receives half of the blubber core.
- No more than max. 1.5 cm is needed for protein analysis so a very deep biopsy may yield a larger POP/DNA fraction.
- The priority analysis is protein so if a small (<1.5 cm) blubber core is obtained, simply separate skin from blubber and dedicate all blubber to protein fraction.
- POP/DNA samples are placed directly into a labelled amber glass vial and kept cool until storage at -20°C onboard the voyage vessel.
- Protein (Adipokine; APK) samples are placed into labelled (e.g. 1A12 APK) cryotubes containing RNA-Later solution. They should be kept cool (i.e. ~4°C) overnight to let the solution penetrate the tissue after which they are placed in the cryoshipper.

Cleaning of Darts and Utensils

- Biopsy dart tips, tweezers and scissors should be washed in warm water with a small amount of mucasol detergent.
- After washing they are rinsed with tap water and Milli-Q water (10 times) before finally rinsing with acetone (can be left to dry on aluminium foil).
- To keep clean between usage, simply wrap the ends of the utensils and dart tips in aluminium foil.

10.4 Equipment

See Section 13.9.

10.5 Data collection

See above and Section 11.10 for the collection datasheet.

10.6 Data management

See Section 11.11.

10.7 Roles and responsibilities

See Section 12.3 as per Close Approach mode for ship biopsy.

10.8 Personnel rosters

See Section 12.1 as per Close Approach mode for ship biopsy.

10.9 Training

See Section 4.

Those processing samples should have read the MSDS for: acetone, liquid nitrogen, mucasol, and AllProtect.

SECTION 11. DATA MANAGEMENT – DATA ENTRY AND BACKUP

11.1 Data management summary

The designated Data Managers for the voyage will:

- Ensure all data streams are operating appropriately (see Section 11.2);
- In consultation with team leaders, oversee quality control of each data stream
- Have sole responsibility of ensuring all back-ups are undertaken successfully and at the frequency described in Section 11.2.

Back-ups

Do **not** overwrite files or folders unless absolutely necessary – create a new folder on the HDD for each back-up and ensure each folder is labelled consistently including the contents, date and time (e.g. YYYY_MM_DD_1215pm_Logger_data).

11.2 Voyage data streams

See Section 11.11.

11.3 Data entry, datasheets and equipment

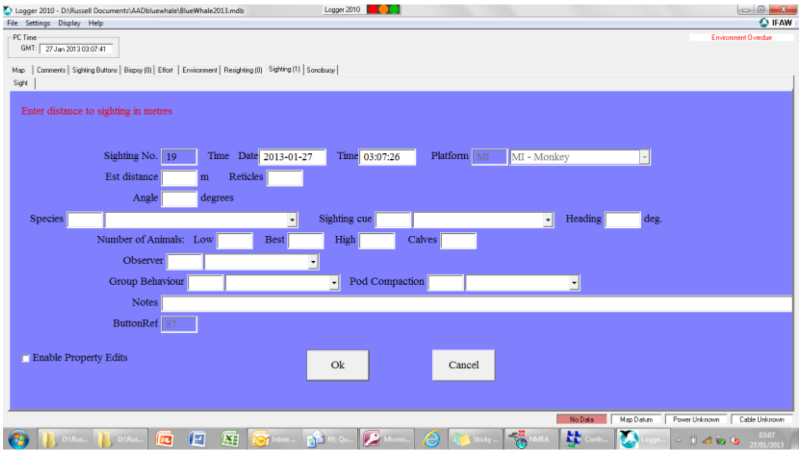
The primary data entry tool during the voyage is Logger and the set-up of Logger is described below.

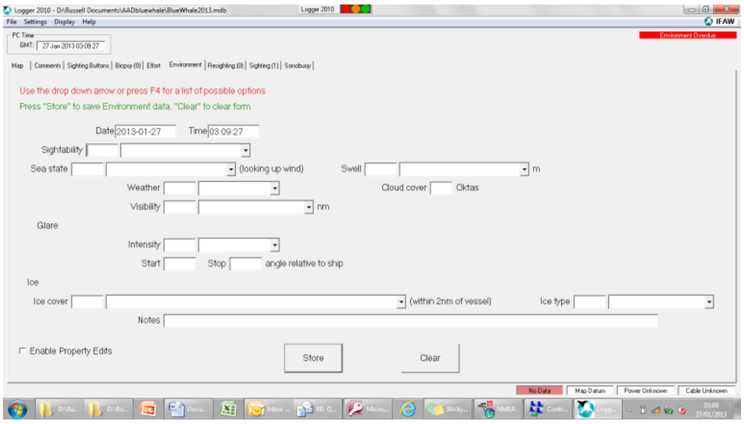
The following sections describe the other written and electronic datasheets or logging tools employed during the voyage. Data management equipment is listed in Section 13.6.

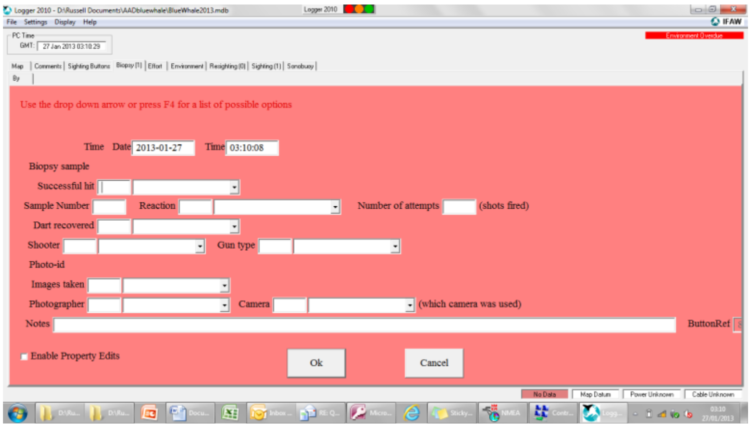
11.4 Logger2010

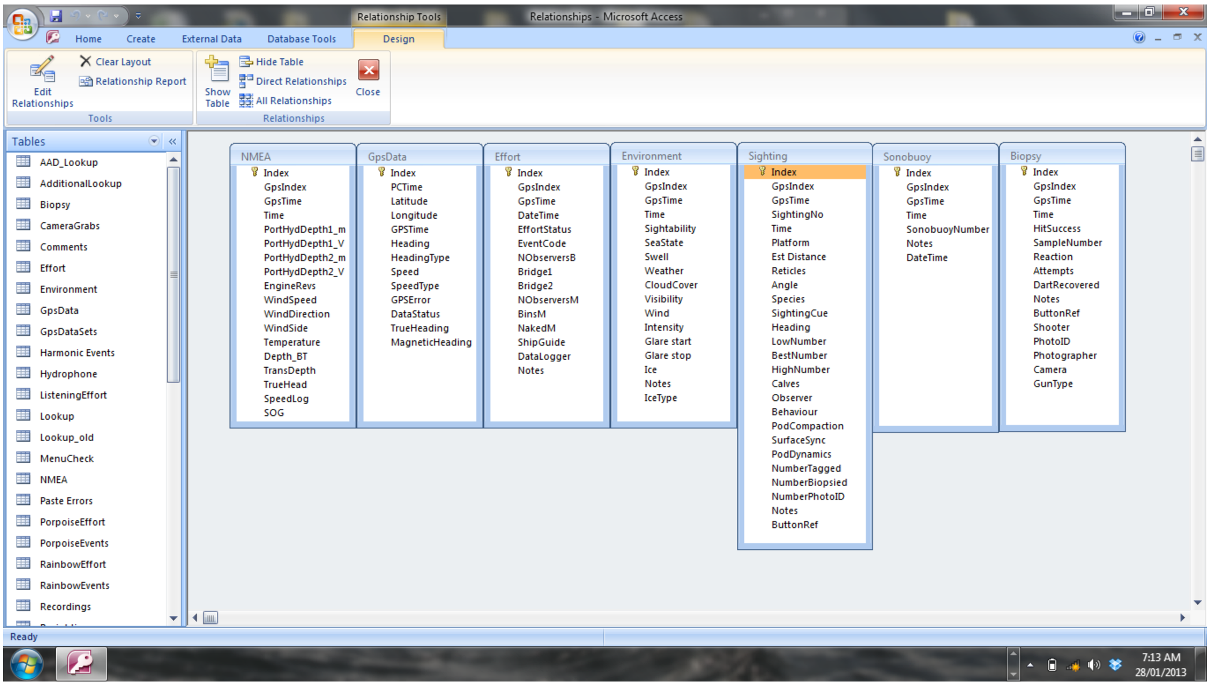
The software program Logger2010 (www.marineconservationresearch.co.uk) will be the primary event logging and data collection tool for the voyage. This software automatically collects data from the ship's GPS and other instruments and stores the data to an Access database. It can also be adapted to create forms to collect event data such as effort, changes in mode, changes in heading, sightings, CTD drops, krill sampling, biopsy sampling and environments data.

Example form screen shots and field names are given below:


Enter distance to sighting in metres
Sighting No. 19
Time Date 2013-01-27
Time 03:07:26
Platform
MI - Monkey
Est distance
m
Reticles
Angle
degrees
Species
Sighting cue
Heading
deg.
Number of Animals: Low
Best
High
Calves
Observer
Group Behaviour
Pod Compaction
Notes
ButtonRef
Enable Property Edits
Ok
Cancel


Use the drop down arrow or press F4 for a list of possible options
Press "Store" to save Environment data, "Clear" to clear form
Date 2013-01-27
Time 03:09:27
Sightability
Sea state
(looking up wind)
Swell
m
Weather
Cloud cover
Oktas
Visibility
nm
Glare
Intensity
Start
Stop
angle relative to ship
Ice
Ice cover
(within 2nm of vessel)
Ice type
Notes
Enable Property Edits
Store
Clear


Use the drop down arrow or press F4 for a list of possible options
Time Date 2013-01-27
Time 03:10:08
Biopsy sample
Successful hit
Sample Number
Reaction
Number of attempts
(shots fired)
Dart recovered
Shooter
Gun type
Photo-id
Images taken
Photographer
Camera
(which camera was used)
Notes
ButtonRef
Enable Property Edits
Ok
Cancel


Relationship Tools
Relationships - Microsoft Access
Home
Create
External Data
Database Tools
Design
Edit Relationships
Clear Layout
Relationship Report
Tools
Show Table
Hide Table
Direct Relationships
All Relationships
Close
Relationships
Tables
AAD_Lookup
AdditionalLookup
Biopsy
CameraGrabs
Comments
Effort
Environment
GpsData
GpsDataSets
Harmonic Events
Hydrophone
ListeningEffort
Lookup
Lookup_old
MenuCheck
NMEA
Paste Errors
PorpoiseEffort
PorpoiseEvents
RainbowEffort
RainbowEvents
Recordings
NMEA
Index
GpsIndex
GpsTime
Time
PortHydDepth1_m
PortHydDepth1_V
PortHydDepth2_m
PortHydDepth2_V
EngineRevs
WindSpeed
WindDirection
WindSide
Temperature
Depth_BT
TransDepth
TrueHead
SpeedLog
SOG
GpsData
Index
PCTime
Latitude
Longitude
GPSTime
Heading
HeadingType
Speed
SpeedType
GPSError
DataStatus
TrueHeading
MagneticHeading
Effort
Index
GpsIndex
GpsTime
DateTime
EffortStatus
EventCode
NObserversB
Bridge1
Bridge2
NObserversM
BinsM
NakedM
ShipGuide
DataLogger
Notes
Environment
Index
GpsIndex
GpsTime
Time
Sightability
SeaState
Swell
Weather
CloudCover
Visibility
Wind
Intensity
Glare start
Glare stop
Ice
Notes
IceType
Sighting
Index
GpsIndex
GpsTime
SightingNo
Time
Platform
Est Distance
Reticles
Angle
Species
SightingCue
Heading
LowNumber
BestNumber
HighNumber
Calves
Observer
Behaviour
PodCompaction
SurfaceSync
PodDynamics
NumberTagged
NumberBiopsied
NumberPhotoID
Notes
ButtonRef
Sonobuoy
Index
GpsIndex
GpsTime
Time
SonobuoyNumber
Notes
DateTime
Biopsy
Index
GpsIndex
GpsTime
Time
HitSuccess
SampleNumber
Reaction
Attempts
DartRecovered
Notes
ButtonRef
Shooter
PhotoID
Photographer
Camera
GunType
Ready
7:13 AM
28/01/2013

11.5 Sonobuoy Deployment Log (electronic only)

buoyID	startDate	startTime	stopDate	stopTime	lat	long	alt	recordingChannel	magVariation	sonobuoyType	receiver	preamp	adc	VHFfreq	wpt
1	2012-01-07	05:56:31	2012-01-07	08:05:00	-38.464528	141.684306	-30	1	-186.8	53D	wr15275	10	ufx10	80	
2	2012-01-07	06:56:00	2012-01-07	08:05:00	-38.490778	141.796472	-30	2	0.0	53D	wr17274	10	ufx10	01	

Electronic log field	Written log field	Description
buoyID	Sonobuoy Number	Sequential number of of each deployed sonobuoy buoy starting at 1 for the first buoy of the trip and incrementing for each buoy including failures.
startDate	Date	Date (UTC) at the start of the sonobuoy deployment (YYYY-MM-DD)
startTime	Time	Time (UTC) at the start of the sonobuoy deployment (HH:MM:SS) 2 digit hour with 24 hour clock and leading zero.
stopDate	Actual Stop Date	Date (UTC) at the end of the sonobuoy deployment (YYYY-MM-DD). While the recording is in progress this should be 1,2 4 or 8 hours after the startTime based on sonobuoy setting.
stopTime	Actual Stop Time	Time (UTC) at the end of the sonobuoy deployment (HH:MM:SS). While the recording is in progress this should be 1,2 4 or 8 hours after the startTime based on the sonobuoy setting.
lat	Latitude	Latitude of deployment in decimal degrees. Southern hemisphere latitudes should be negative.
long	Longitude	Longitude of deployment in decimal degrees. Western hemisphere longitudes should be negative.
alt	Depth	Depth of the sonobuoy deployment in metres. For DIFAR sonobuoys either 30, 120 or 300.
recordingChannel	Matlab channel	This is the channel number within the recorded wav-file that contains audio from this buoy as would be reported by Matlab. Channel numbers start at 1 (1-indexed) so usually this will be 1, 2 or 3.
magVariation	-	The magnetic variation in degrees. Positive declination is East, negative is West. At the start of a recording this will be 0. After ‘calibration’, this should be updated by measuring the bearing to the vessel (using matlab scripts difarVessel and sonobuoyDeviation).
sonobuoyType	-	The an/ssq designation for the type of sonobuoy. Usually 53B, 53D, 53F, which are DIFAR buoys, but possibly 57A/B (‘wideband’ omnidirectional), or 36Q (bathythermograph).
receiver	Receiver	The type and serial number of the radio receiver used to receive the VHF signal. (wr15725, wr17274, wr15274, or wr15273, for 2909i receivers, or 12A19002, 12A19005,

Electronic log field	Written log field	Description
		12A19007, or 12A19009 for the WSB39e receivers)
preamp	-	The gain in dB of any preamplifier (including the instrument preamp from the Fireface UFX). Usually 10, 20, or 30 dB.
adc	-	The analog-to-digital converter (adc) used to digitize the audio. This is the sound card name and gain. Usually ufx10 for the RME Fireface UFX.
vhfChan	VHF channel	Transmitting VHF channel for the sonobuoy (01-99)
waypoint	Waypoint	Waypoint identifier in the acoustics GPS created for the sonobuoy deployment location. In Garmin GPS units, each new waypoint is numbered sequentially.

11.6 Sonobuoy Events Log

Written version

Sonobuoy Number		Sonobuoy Number		Sonobuoy Number	
Pamguard Channel		Pamguard Channel		Pamguard Channel	

Date:		VHF Channel:	
Time:		Duration:	
Latitude:		Depth:	
Longitude:		Waypoint:	
Actual stop date:		Receiver:	
Actual stop time:		Matlab Channel:	

Time	***SB***	***Call type***	***Strength***	***Direction***	***Notes***

Electronic version

Electronic log field	Written log field	Description
buoyID	SB	buoyID number from the Sonobuoy Deployment Log on which the sound was detected
timeStamp	Time	Date and time (UTC) of the start of the sound stored as a Matlab datenum in the electronic log, and the time as HH:MM in the written log
latitude	-	The associated latituds, longitude, depth, and magVariation from the Sonobuoy Deployment Log that corresponds to buoyID at the time when the sound was analysed.
longitude	-	
altitude	-	
magneticVariation	-	
bearing	-	The uncorrected magnetic bearing (in degrees) from the sonobuoy to the sound source. The corrected bearing can be

		obtained by subtracting magVariation from this field.
frequency_Hz	-	The frequency (in Hz) selected from the DIFARgram that corresponds to the best bearing. This is selected by the acoustician.
logDifarPower	-	The height of the DIFARgram at the selected frequency and bearing. This measurement is measure of the 'directional-strength' of the call.
receiveLevel_dB	-	The RMS receive level in dB SPL re 1 uPa at the selected frequency. This is computed from the spectrum of the sound multiplied by calibration data for the entire recording chain.
soundType	Call type	A description of the acoustic event (eg 28 Hz tone, Z-call, D call, etc.)
-	Direction	Corrected bearing relative to true North from the sonobuoy to the analysed sound measured in degrees. Direction = bearing - magneticVariation
-	Notes	Any Additional notes about analysed sounds. Use] to denote the same sound event recorded on two different buoys. Write latitude and longitude of all crossed bearing triangulations. Note noise sources, strange vessel manoeuvres, gear failures, and relevant information from visual observers and voyage management.

11.7 Written Whale Tracking Log

<table>
<tr><td>Date</td><td colspan="2">(UTC) written only at top of datasheet</td></tr>
<tr><td>Time</td><td colspan="2">(UTC) on the hour, 15 past, half past, and 15 to.</td></tr>
<tr><td rowspan="3">Track</td><td colspan="2">Sequential track number for each whale tracked in the past 15 minutes.
Each track will have:</td></tr>
<tr><td>Location</td><td>Either a bearing from a sonobuoy (eg 220° from SB18) or a Lat/Lon from the most recent triangulation</td></tr>
<tr><td>Notes</td><td>What is the vessel action with respect to this tracked whale? (eg. Is this the current or previous 'target'? Are we presently photographing this whale? Did we finish photographing the whale?) Has the whale gone silent? Has this track crossed paths with another?</td></tr>
</table>

11.8 Written RHIB Field Datasheet

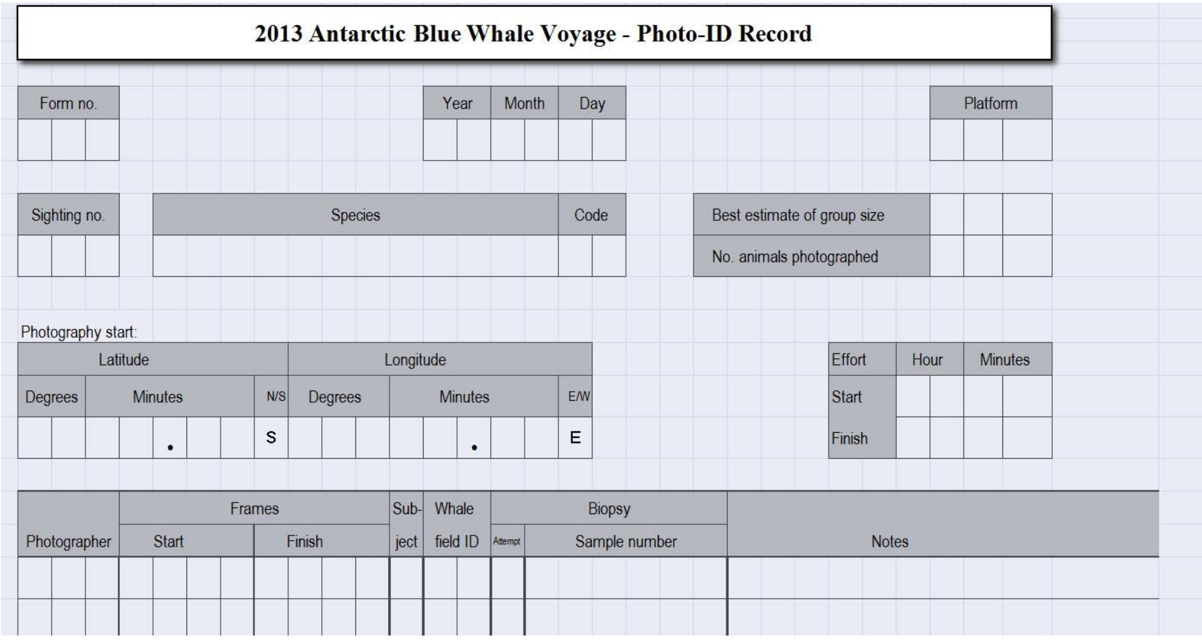
Sheet #		Date:	Vessel:		Crew:	*Driver - Tag -*	Launch Time:	Time In:	Wind Speed (knots)	Beaufort Force:	Swell:
					Biop - Data -	*Photo -*					
Pod Information		*Species:*		*Sighted From:*							
Pod #		Time sighted			Sight Pod Waypoint			Sight Pod Bearing		Sight Cue	
Pod Comp			Waypoint On		Time On			Waypoint Off		Time off	
Start Frame #			End Frame #		Total # approaches			Evasive (Y/N)			
Individual Information											
General		***Tagging***		***Biopsying***		***General***		***Tagging***		***Biopsying***	
Ind #		Tagged (Y/N)		Biopsy (Y/N)		Ind #		Tagged (Y/N)		Biopsy (Y/N)	
Age Class		Tag #		Sample #		Age Class		Tag #		Sample #	
Body Cond.		Waypoint		Waypoint		Body Cond.		Waypoint		Waypoint	
Behaviour		Time		Time		Behaviour		Time		Time	
Evasive (Y/N)		Pressure (Bars)		Reaction (1-3)		Evasive (Y/N)		Pressure (Bars)		Reaction (1-3)	
		Shot Distance (m)		No. of attempts				Shot Distance (m)		No. of attempts	
		% implant						% implant			
		Reaction (1-3)		***Photo ID***				Reaction (1-3)		***Photo ID***	
		Photo (Y/N)		Photo ID (Y/N)				Photo (Y/N)		Photo ID (Y/N)	
		Frame #		Frame # (L)				Frame #		Frame # Dorsal (L)	
		Side of animal (L/R)		Frame # (R)				Side of animal (L/R)		Frame # Dorsal (R)	
										Frame # Fluke	
Comments						**Comments**					
Labels: Time in UTC; Sight cue - BL=Blow BR=Breach PS=Peck Slap TS=Tail Slap; Pod Comp/Age Class - AD=Adult SA=SubAdult CA=Calf; Body Condition - Poor/Good; Behaviour - Travelling/Feeding/Logging/Surface Active; Reaction (1-3) - 1=negligible, 2=mild, 3=extreme											
Note: Pod number begins at 1 for each day, individuals number begins at 1 for each new pod.											

11.9 Electronic Whale vocalisations and behaviour datasheet

Field	Description
Encounter Number	The encounter number from observations (see Objective 1). This will link behavioural observations to a particular encounter
Bearing to whale	Angle from main vessel heading to the designated whale
Range to whale	Approximate distance from main vessel to the designated whale
Whale designation	Each individual whale that has behavioural observations will be assigned a designation to distinguish observations
Designation certainty	The certainty that the observed whale is the designated whale on a scale of 1-5, where 1 means not at all certain, and 5 means absolutely sure
First blow	Time of the first blow if the behavioural observer saw the first blow of a series of breaths. Since the dictation will be time-stamped, simply dictating “first blow” is typically adequate.
Dive time	Time when the whale leaves the surface to dive

Surface behaviour	Any activities that the whale conducted at the surface. Notable behaviours include, but are not limited to: Swimming a straight course, turning, lunging (mouth open), turning on side, fluke out dive, lobtailing, spyhopping, breaching, close interactions with other whales (touching/swimming together).
Other notes	Other contextual information, for example: the presence of krill, sea ice, or other species.

11.10 Written Photo-Identification datasheet


2013 Antarctic Blue Whale Voyage - Photo-ID Record

Form no. | Year | Month | Day | Platform

Sighting no. | Species | Code | Best estimate of group size | No. animals photographed

Photography start:

Latitude			Longitude		
Degrees	Minutes	N/S	Degrees	Minutes	E/W
	.	S		.	E

Effort	Hour	Minutes
Start		
Finish		

Photographer	Frames Start	Frames Finish	Sub-ject	Whale field ID	Biopsy Attempt	Biopsy Sample number	Notes

11.10 Written Humpback whale sampling datasheet

DATE	**TIME**	**LABEL**	Class Definition: **S**-Singleton; **M**-member of a pair; **N** -non-competitive trio; **C** -mother/calf pair; **E** - escort to m/c pair; **P**-competitive pod; **F** – feeding aggregation	NOTES (condition of individual, markings, fluke photo obtained etc)	Sample Storage Location (i.e. Cryoshipper and/or -20°C freezer)
		001_HBKW_20130212			
		002_HBKW_20130212			
		003_HBKW_20130212			
		004_HBKW_20130212			
		005_HBKW_20130212			

11.11 Voyage data streams – summary

	Data type	Primary data entry	Data form	Data entry location	Data file final	Data file final location	Data back-up to	Back-up frequency
1	Obs data - sightings, weather	Logger	Electronic	Logger computer - bridge	Logger Access database	Logger computer c:/Data/	HDD - Logger	12 hours
2	Logger GPS	Automatic - Logger	Electronic	Logger computer - bridge	Logger Access database	Logger computer c:/Data/	HDD - Logger	12 hours
3	Video footage	Video camera	Electronic	Flying Bridge, Bridge	Video folders by day and camera	RLs laptop	HDD - Video	Daily
4	Video footage transcription	Whale Voc & Behaviour Datasheet	Electronic	Flying Bridge, Bridge	Whale Behaviour Datasheet	RLs laptop	HDD - Video	Daily
5	Sonobuoy audio	Audio daily folder	Electronic	Acoustic workstation	Audio daily folder	Acoustic workstation c:/Data/	HDD - Acoustics1 & 2	Daily
6	Sonobuoy deployment	Logger	Electronic	Logger computer - bridge	Logger Access database	Logger computer c:/Data/	HDD - Logger	12 hours
7	Sonobuoy deployment	Sonobuoy Deployment Log	Electronic	Acoustic workstation	Sonobuoy Deployment Log	Acoustic workstation c:/Data/	HDD - Acoustics1 & 2	Daily
8	Sonobuoy deployment	Sonobuoy Event Log	Written	Acoustic workstation	Sonobuoy Event Log	Hardcopy	n/a	n/a
9	Whale tracking	Whale Tracking Log	Written	Acoustic workstation	Whale Tracking Log	Hardcopy	n/a	n/a
10	Acoustics GPS text file	Automatic - csv file	Electronic	Acoustic workstation	GPS files	Acoustic workstation c:/Data/	HDD - Acoustics1 & 2	Daily
11	Photo-ID images	Cameras	Electronic	Flying Bridge, Bridge, Bow	Photo folders by day and camera	Photo-ID laptop c:/Data/	HDD - Photo-ID	Daily
12	Reconciled photo-ID images	n/a	Electronic	n/a	Photo folders by individual whale	Photo-ID laptop c:/Data/	HDD - Photo-ID	Daily
13	Photo-ID data	Photo-ID Datasheet	Written	Flying Bridge, Bridge, Bow	Photo-ID Access Database	Photo-ID laptop c:/Data/	HDD - Photo-ID	Daily
14	Biopsy events (ship)	Logger	Electronic	Logger computer - bridge	Logger Access Database	Logger computer c:/Data/	HDD - Logger	12 hours
15	Biopsy events (ship)	RHIB Field Datasheet	Written	Ship	RHIB & Biopsy Access Database	RHIB & Biopsy laptop c:/Data/	HDD - RHIB & Biopsy/	Daily
16	Biopsy samples summary	Biopsy Samples Spreadsheet	Electronic	Officers mess	ABWV Biopsy Samples Spreadsheet	RHIB & Biopsy laptop c:/Data/	HDD - RHIB & Biopsy/	Daily
17	RHIB GPS location data	RHIB GPS	Electronic	RHIB	RHIB GPS files	RHIB & Biopsy laptop c:/Data/	HDD - RHIB & Biopsy/	Daily
18	RHIB sightings, biopsy, tagging	RHIB Field Datasheet	Written	RHIB	RHIB & Biopsy Access Database	RHIB & Biopsy laptop c:/Data/	HDD - RHIB & Biopsy/	Daily
19	Krill collection	Logger event	Electronic	Logger computer - bridge	Logger Access database	Logger computer c:/Data/	HDD - Logger	12 hours
20	Satellite tag location data	Automatic - Argos system	Electronic	Automatic - Argos system	Enterprise database - AAD Data Centre	AADC Database	Data farm	Daily
21	Incidental media - video	Cameras	Electronic	Flying Bridge, Bridge, Bow	Photo folders by day and photographer	Photo-ID laptop c:/Data/Incidental_video/	HDD - Photo-ID	Daily
22	Incidental media - photos	Cameras	Electronic	Flying Bridge, Bridge, Bow	Photo folders by day and photographer	Photo-ID laptop c:/Data/Best_of/Name/	HDD - Photo-ID	Daily
23	Ship GPS location, heading, depth, SST	Automatic - ship	Electronic	Ship	As original	Logger computer c:/Data/	HDD - Logger	Daily if possible
24	Delivered sea ice data - polarview	n/a	Electronic	n/a	As original	Logger computer c:/Data/	HDD - Logger	Daily
25	Delivered weather information	n/a	Electronic	n/a	As original	Logger computer c:/Data/	HDD - Logger	Daily
26	Delivered SST, Chl-a	n/a	Electronic	n/a	As original	Logger computer c:/Data/	HDD - Logger	Daily
27	CTD deployments	Logger event	Electronic	Logger computer - bridge	Logger Access database	Logger computer c:/Data/	HDD - Logger	12 hours
28	CTD deployment data	Automatic CTD	Electronic	Automatic CTD	CTD files	Acoustic workstation c:/Data/	HDD - Acoustics1 & 2	Daily

DO NOT OVERWRITE FOLDERS AND FILES DURING BACK-UPS - CREATE NEW FOLDERS

SECTION 12. PERSONNEL ROSTERS AND DUTIES BY MODE

12.1 Observations roster (VT mode)

The table below summaries the roster during the voyage while operating in Visual Transect, Acoustic Bearing or Visual Bearing modes. For other modes other personnel will be brought onto 'duty' – see Duties by Mode table below. While not on 'duty' or with a specific task (and having had reasonable sleep and personal time) it would be expected that all personnel will be on the bridge or Flying Bridge as capacity allows.

Start	Finish	Paula (lead)	Carlos	Kylie	Victoria	DVL	Doc	Paul (lead)	Nat	Mindy	Dave	Mick	Virginia
1:00	2:00												
2:00	3:00												
3:00	4:00												
4:00	5:00	1		1		1							
5:00	6:00	1		1		1							
6:00	7:00	2			2	2							
7:00	8:00	2			2	2							
8:00	9:00		3		3		3						
9:00	10:00		3		3		3						
10:00	11:00	4	4	4									
11:00	12:00	4	4	4						Acoustics			
12:00	13:00	5		5			5			Acoustics			
13:00	14:00	5		5			5			Acoustics			
14:00	15:00		Acoustics					6	6				6
15:00	16:00		Acoustics					6	6				6
16:00	17:00		Acoustics					7		7			7
17:00	18:00							7		7			7
18:00	19:00								8	8	8		
19:00	20:00								8	8	8		
20:00	21:00							9			9	9	
21:00	22:00							9			9	9	
22:00	23:00							10	10			10	
23:00	0:00							10	10			10	
0:00	1:00												
Acoustic hours			3							3			
No. Hours		8	7	6	4	4	4	8	6	7	4	4	4

12.2 Acoustics roster

The lead acoustician will work a 12 hour shift, while four acousticians will work shifts of 10 hours (including 4 hours of 'on call' time) with one hour of overlap with the preceding and following shifts. Acousticians will adhere to the fatigue management policy by adhering to the roster, ensuring adequate sleep, and reduction of on-call duties when fatigued.

Time	Miller	Calderan	Leaper	Barlow	Collins
0:00					
1:00					On call
2:00					On call
3:00					
4:00		On call			
5:00		On call			
6:00					
7:00			On call		
8:00			On call		
9:00					
10:00		On call			
11:00		On call		Rekdahl	
12:00				Rekdahl	
13:00			On call	Rehdahl	
14:00			On call	Olavarria	
15:00				Olavarria	
16:00				Olavarria	
17:00				On call	
18:00					
19:00					On call
20:00					On call
21:00					
22:00				On call	
23:00				On call	

12.3 Personnel duties by mode

Below is a provisional table of duties (other than acoustics) for personnel while in the various operational modes of the voyage. This is table is likely to change during the voyage under the discretion of the Science Leader as personnel gain experience and skills in other roles.

Modes	Roles	Location	Personnel	Personnel
Visual transect plus AB and VB modes	Logger data entry	Ship	See roster	See roster
	Searcher	Ship	See roster	See roster
	Searcher	Ship	See roster	See roster
			AM shift	**PM shift**
With Whales	Ship guide	Ship	Jay (Paul)	Jay (Paul)
	Logger data entry	Ship	Victoria	Virginia
	Video tracking and commentary	Ship	Susie (Carlos)	Russell (Mindy)
	Searcher	Ship	Kylie	Dave
	Searcher/prep for CA mode	Ship	Paula	Nat
	Prep for CA mode	Ship	Doc/DVL	Mick

Modes	Roles	Location	Personnel	Personnel
			Any shift	
Close Approach	Ship guide	Ship	Jay (Paul)	
	Logger data entry	Ship	Virginia	
	Searcher	Ship	Mindy	
	Searcher	Ship	Kylie	
	Bow photo-ID 1	Ship	Nat	
	Bow photo-ID 2	Ship	Paula	
	Larsen 1	Ship	Paul (Dave)	
	Larsen 2	Ship	Carlos	
	Larsen buoys/retrieval	Ship	Crew/Mick	
			Any shift	
RHIB mode	Coxswain	RHIB	Dave/Mick	
	Coxswain/photographer	RHIB	Mick/Virginia	
	RHIB data	RHIB	Nat	
	RHIB biopsy	RHIB	Virginia/Mindy	
	RHIB tagger	RHIB	Virginia/Mindy	
	Ship guide	Ship	Jay	
	Logger data entry	Ship	Victoria	
	Searcher/photo-ID	Ship	Carlos	
	Searcher/photo-ID	Ship	Paula	
	Larsen 1	Ship	Paul	
	Larsen photographer 1	Ship	Kylie	
	Larsen buoys/retrieval	Ship	Crew	

SECTION 13. EQUIPMENT

13.1 Observations and Photo-ID equipment

- Wind-blocker platform(s), located on the Flying Bridge
- Angle measure secured to some surface.
- UHF handheld radios
- Laptop with Logger and MS Access database facilities
- GPS – plugged into Logger laptop and antenna
- Digital cameras (x2) + 8 personal SLRs
- Zoom lenses
- Pelican cases
- Field notebooks and pencils
- Lens cleaning cloth
- Batteries
- Storage cards
- Stop watches for dive times and ship guiding
- 50 x 7 marine binoculars, with reticles, with attachment to a pole for ease of use and stability.
- Field guides for species identification
- PPE

13.2 Passive acoustic equipment

- DIFAR sonobuoys – X palettes with 48 sonobuoys per palette
- Workstations for real-time acoustic tracking (2 Advantech PCs, 2 ThinkStations, with keyboards, mice & monitors)
- GPS for acoustic workstation (Garmin 700, 555, and 87)
- Sound recording boards (3x RME Fireface UFX)
- VHF receivers (4 WiNRADiO G39WSBe, 3 ICOM-R1000, 4 WiNRADiO 2909i-inside PCs)
- VHF antenna (3 3-dB antenna to be mounted on mast as high as possible on vessel superstructure)
- Masthead amplifier (3 Minicircuits ZMSC-4-3-BR+6 with 3 pairs of bias-Ts for power)
- UPS to provide power and filtration for all equipment above (3, Digitech line-interactive 1500VA supplies)
- Lifejacket and handheld locator beacon (to wear when deploying sonobuoys)
- Sound velocity profiler or CTD (TBD)
- Spare LMR400 coaxial cable and N style connectors (and crimping tool) for antennas and receivers
- Toolbox (including: large screwdriver for opening sonobuoys, snips, soldering kit, spare connectors, hand tools, and cordless drill)
- Electronic diagnostic equipment (2 multimeters, digital oscilloscope)
- Portable UHF radios (note: VHF is not compatible with sonobuoy deployments) with charging station.

13.3 Biopsy sampling equipment (ship & RHIB)

- RHIB field datasheet
- Rifle – Larsen (x2)
- Rifle – Paxarms (x3)

- Rifle bolts
- Rifle magazines
- Lanyards
- Larsen darts (x40)
- Larsen dart discs (x200)
- Braided line
- Buoy for test firing
- Reels
- Gun bags
- Ammunition
- Ammunition boxes
- Pelican cases
- Safety glasses, ear plugs
- Paxarm manual
- Larsen manual and user guide
- Scope manual
- Scope batteries, lens cloth
- Silicone
- Push rod for removal of darts from barrel
- Gun oil and cloth, WD40
- Screwdrivers, knif, long-nosed pliers
- Head sharpener and barb resetter
- Toolbox and tools (pliars for removing stuck cartridges, screw driver for changing batteries)
- 'Whiteboard' and pens or magnetic numbers
- Waterproof markers for labelling darts
- Zip lock bag
- Dissection kit including forceps
- Scalpel blades, toothbrush, mild bleach, marker pen, disposable gloves, tissues, all weather pen
- Eppendorfs and boxes
- Preservatives - 70% Ethanol and AllProtect
- ddWater, measuring cylinders, P1000 pipette and dropping pipettes
- Duct tape, super glue, cable ties

Biopsy retrieval from the ship

- Buoys (x5)
- Long handled nets (x3) 5-6 metre strong, light handles, hoop approx 75cm diameter, strong mesh of appropriate size to retain darts, attachment line to prevent loss overboard
- Long handled hooks (x2) 5-6 metres strong light handles, attachment line to prevent loss overboard

13.4 Behavioural observations equipment

- Video-binocular mounting frames (x2)
- Monopods with ball heads (x2)
- HD video cameras (x2)
- Digital cameras (x2)
- SLR and mounted mini-video camera (x1)
- Microphone

For further information of equipment see Leaper & Gordon (2001).

13.5 Satellite tagging equipment

- Line thrower (barrel, chamber and butt), lanyard if required
- Air line for line thrower- complete with valve
- Scuba tank
- Satellite tags
- Tagging bolts
- Tag protective tubes for PLT, & red caps
- Telonics receiver, spare battery & cover (pre-program receiver using argos & hex codes)
- Side cutters
- Stanley flick knife
- Lanyards for firearms
- Dip net
- Straps (dive tank attachment method on RHIB)
- Magnets
- Data sheets
- Dry bags
- GoPro camera & housing, memory cards, battery backpacks, charging cable
- Helmet with GoPro mount in preferred location
- Personal Floatation Device (PFD)
- Personal Locator Beacon (PLB)
- Dry suits
- Satellite phone
- Biopsy equipment (see Section 13.3)
- Photo-identification equipment (see Section 13.1)
- Cameras and lenses
- Camera memory cards
- Binoculars
- Laptop computers with databases and back-up facilities
- Identify equipment (including PPE) and supplies required for this procedure.
- Ensure equipment & machinery is properly maintained and stored

13.6 Other RHIB equipment

- Handheld GPS and spare batteries
- Retrieval nets
- Eski and ice packs
- GoPros, camera and spare batteries

13.7 Krill sampling equipment

- Personal protective gear: hard hat, leather work gloves, appropriate pfd and cold weather clothing.
- Plankton net (conical: 1.2 meter wide opening, 2.5 m long) fitted with clamped cod end for sample recovery.
- A rope for deployment of net from the vessel.

- Winch (or capstan) with wire line (or rope) present on the vessel would be required for trawling.
- 95% ethanol, sample containers and sample labels.

13.8 Kite equipment

- Kites (1 small, high windspeed kite, 2 low windspeed kites)
- Kite string (1 yellow hand reel 250 m, 1 stainless steel rotary winder 150 m)
- Kite tails (4 x 4 m tails)
- Kite paddle with double pleats
- Breakaway links (70 kg test)
- Hooks for attachment of payloads
- Kite bag (black nylon bag “Northwest Passage”)
- Personal Protective Equipment, Gloves (to be worn when handling kite-line)
- Knife (emergency use for release of entanglements)
- VHF antenna
- VHF masthead amplifier, power supply, and low-loss shielded cable (Belden 7500)
- Lightweight clips (clothes pins, and elastic bands)Cable storage (reel and bucket)
- Canon camera
- SD card with CKDK firmware (Canon Hack Development Kit)
- Aluminium bracket and housing for attachment of camera to kite-line
- AA batteries
- Real-time acoustic tracking system (See Objective 1 – Subheading: Passive Acoustics)

13.9 Humpback biopsy equipment

See Section 13.3 for general biopsy equipment.

- Nitrile gloves
- SC20/12 MVE cryoshipper
- 5 mL cryotubes
- Stainless steel tweezers and scissors
- Aluminium Foil
- Kimwipes
- Bottle brushes for cleaning dart tips, scissors and tweezers
- Observation sheets
- Furnaced amber glass vials
- AllProtect
- Acetone - for rinsing cutting heads and scissors/tweezers
- Mucasol - detergent for cleaning darts
- Milli-Q water

13.6 Data management equipment

- Logger data laptop
- Photo-ID data laptop
- Small boat data laptop
- Spare laptops (x2)

- 2TB HDD Logger
- 2TB HDD Photo-ID
- 2TB HDD Small boat
- 2TB HDD Video
- 2TB HDD Acoustics1
- 2TB HDD Acoustics1
- 2TB HDD Spare
- Cables
- Adobe Photoshop Elements
- Video editing software

SECTION 14. REFERENCES

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SECTION 15. APPENDIX 1 – ACOUSTICS SET-UP PROCEDURES

15.1 Setting up (after all hardware has been connected)

1) Boot the sonobuoy computer -- Username: .\sonobuoy   Password: BlueWhale2012
2) Start GPS logging
    a. Turn on the GPS
    b. Run RealTerm by double clicking on the icon on the desktop, or the icon on taskbar.
        i. If (and only if) there is an error message 'Unable to open capture file' then click 'Start Overwrite' to create a new gps data file (c:\data\gps\gpsNMEA.txt).
3) Run WiNRADiO Sonobuoy from the desktop. Make sure the receivers are detected.
4) Run Pamguard.bat from the desktop/taskbar to start pamguard.
    a. Select the preset (difarMonitor1 for 1 sonobuoy, difarMonitor2 for two sonobuoys etc.).
    b. Don't start recording just yet.
5) Restore TotalMixFX, which will be hiding in the system tray.
    a. Load the correct workspace (difarMonitor1 for one sonobuoy, difarMonitor2 for two sonobuoys etc.).
    b. Optional: Open Fireface UFX settings (fire icon in system tray). If sample rate is not 48,000 Hz, reset sample rate to 48,000 Hz, leaving other settings as is.
6) Run Matlab.
    a. Start difar tracking with the command: startDifar
7) Open the sonobuoy deployment log (sonobuoyLog.xls) in Excel
8) When in position, proceed to deploy a new sonobuoy.

15.2 Sonobuoy deployment

1) Prefill the sonobuoyLog.xls with the details of the new sonobuoy (buoyID: X). Fill in everything except latitude, longitude, and start and end time.
2) Fetch a sonobuoy: Set the channel, duration, and depth of the sonobuoy.
    a. If deploying to 300 m, use a lever to remove the plastic parachute retaining cap, otherwise leave the cap and parachute in place.
3) Radio the bridge that you are preparing to deploy sonobuoy number X. Wait for confirmation.
4) Radio the bridge that sonobuoy X is away, then throw the sonobuoy overboard so that the parachute enters the water last.
5) Quickly return to the workstation and mark a waypoint on the GPS.
6) Start recording in Pamguard by hitting the round red button (yes, the one that ironically looks like a stop sign).
    a. Make sure the raw audio recorder is set to continuous.
    b. Make sure the vessel clip recorder is set to auto.
    c. The user selection recorder should be set to off (but user clips will still be saved).
7) Finish filling out the sonobuoyLog.xls.
8) Double check that the dates, times, and channel numbers in the sonobuoy log are correct.
9) Make sure that wav files with the correct timestamp and number of channels are being written to c:\data\audio\
10) Once the sonobuoy log is correct, process the vessel clips and determine the sonobuoy correction (magnetic deviation).

15.3 Sonobuoy correction (magnetic variation)

Each sonobuoy has a magnetic compass to determine the direction of the bearings. The following steps compute the magnetic variation of this compass. This must be done before processing any whale bearings.

1) Make sure that the magVariation for the sonobuoy is 0 in the sonobuoy log.
2) Make sure vessel clips are being recorded.
3) In Matlab, run difarVessel to process the vessel clips and obtain difar bearings to the vessel.
4) Keep running difarVessel until you have 10-20 sucessful bearings to the vessel.
5) Run sonobuoyDeviation in matlab.
6) Copy and paste the new magVariation into the sonobuoy log.
7) Turn off the Vessel Clip Recorder and delete any remaining files in C:\data\vesselClips\

15.4 Tips for Tracking whales

- Watch the spectrogram in Pamguard and listen to the audio using headphones.
- Make clips of any interesting sounds by clicking and dragging on the spectrogram.
    - When making a clip of a whale sound, select a few (2-4) seconds of audio before the start of the sound. The analysis software requires a few seconds of audio to lock onto the DIFAR signal.
    - End the clip as close to the end of the sound as possible. This reduces the amount of noise present in the clip.
    - For D calls make clips of each individual call rather than a single clip for a group of calls.
    - Don't clip sounds that have strong noise present. The resulting bearings would be confounded by the noise.
- Occasionally check on the full bandwidth spectrogram. Make sure the DIFAR carrier signals are present at 7.5 and 15 kHz, and that the sidelobes (0-3, 12-18 kHz) are well above the noise floor.
- D calls can be difficult to see/hear when the VHF reception is poor. Noise bands from poor VHF reception generally span the whole bandwidth from >100 Hz down to 0 Hz, while D calls usually have a limited bandwidth and do not go down to 0 Hz (at least I've not seen one yet).
- When processing clips in Matlab:
    - Check the duration of the sound clip (on the X-axis of the spectrogram) to make sure the clip is at least a few seconds long.
    - When choosing a bearing, avoid frequencies that have strong noise in the spectrogram.

15.5 Sonobuoy recording and tracking system overview

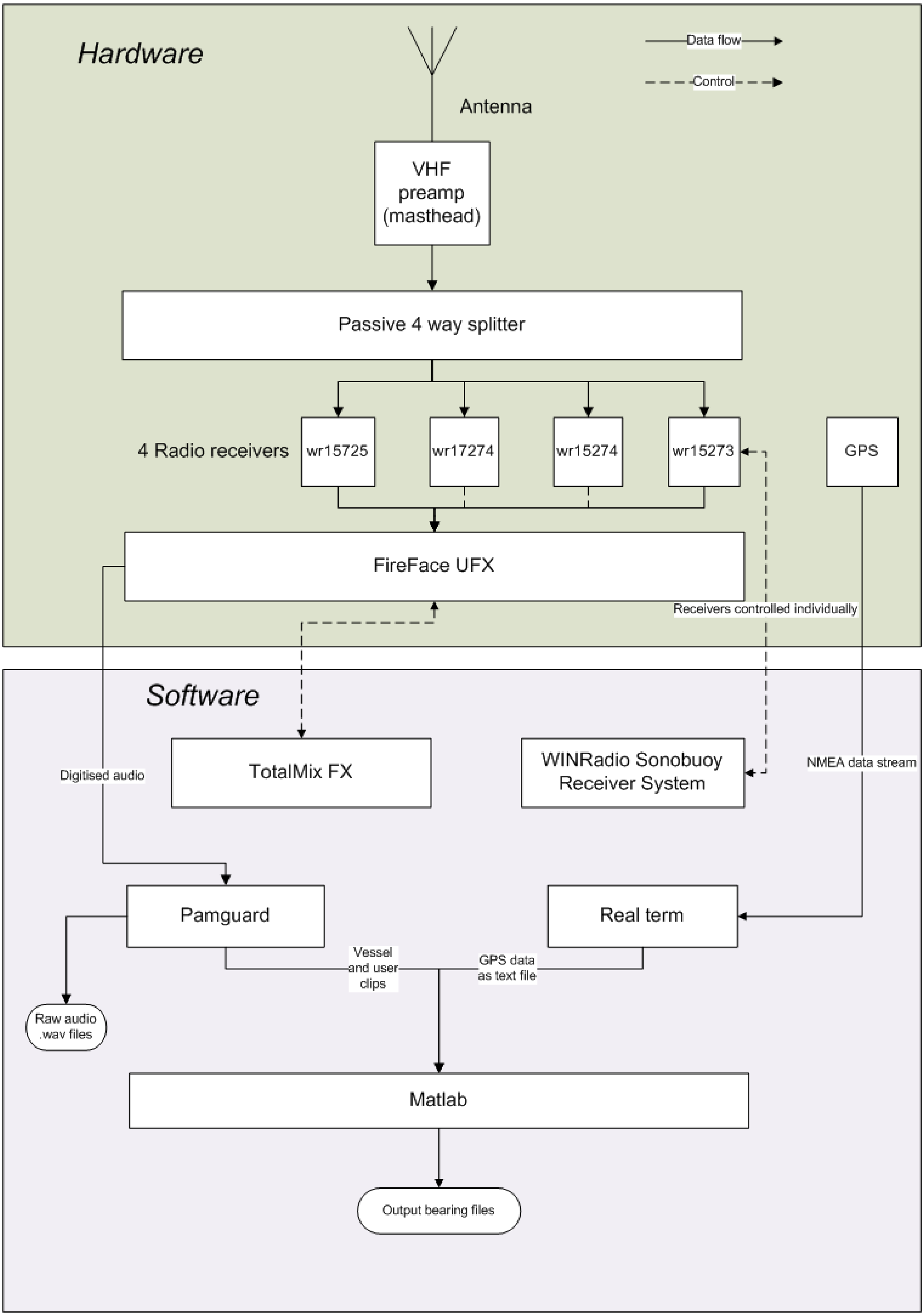


Figure 4 - Sonobuoy recording system: data flow and control

The recording chain consists of a high gain antenna and masthead amplifier connected to a passive four way splitter (presumably with 6 dB loss). The antennae is connected to the splitter with low loss cable. Each output of the four way splitter is connected to the DIFAR input of a WiNRADiO 2902i sonobuoy receiver. DIFAR outputs from each of the 2902i are connected to the instrument input of an A/D converter. The A/D converter used was a RME Fireface UFX. The UFX is connected to the computer via either USB or firewire.
The digitised signals from the UFX are saved as WAV files with 48 kHz sample rate using passive acoustic monitoring software Pamguard. Pamguard also provides for viewing of spectrograms, while the RME TotalMix software allowed the incoming audio to be monitored. Figure 5 shows a screenshot of the incoming data and associated software programs during a typical recording session.

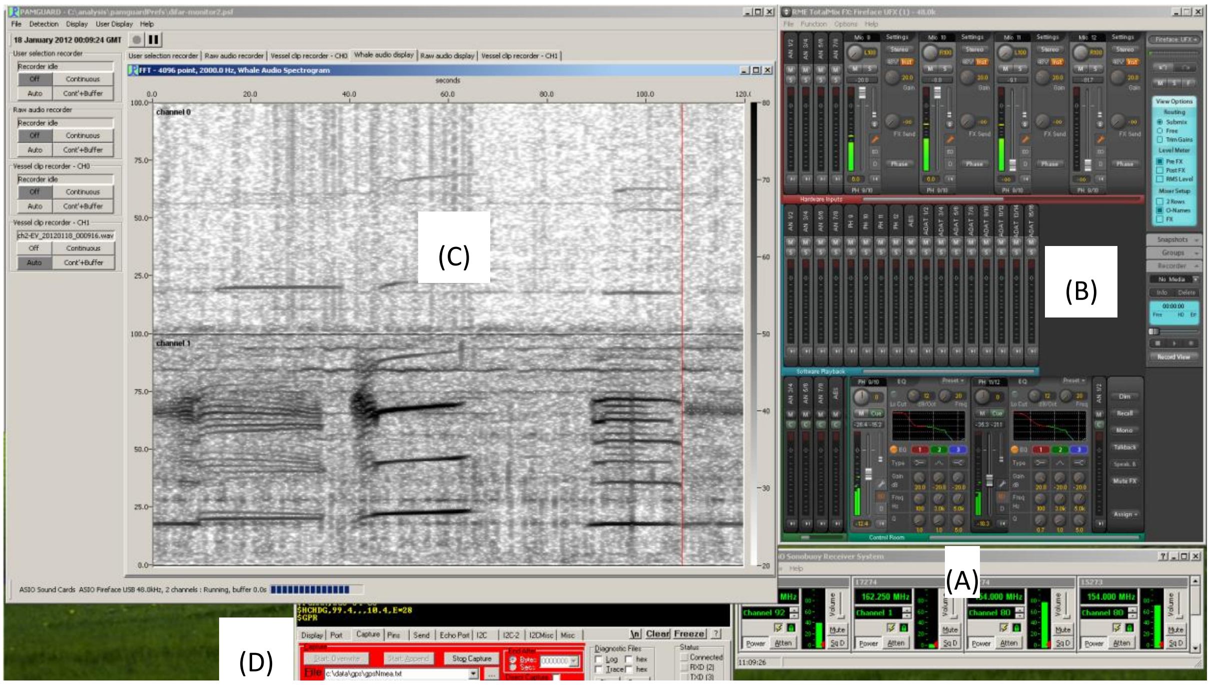


Figure 5 – Incoming data screenshot showing (A) WinRadio Sonobuoy Receiver Control showing VHF radio RSSI (vertical green bars). (B) TotalMix Sound card gain control and audio monitoring. (C) Pamguard showing incoming audio and whale sounds from two sonobuoys. (D) Realterm logging NMEA data from the GPS receiver.

Audio clips of blue whale sounds and any vessels in the area are saved separately from the raw audio stream by selecting the sounds of interest in the spectrogram window. Clips are and analysed with custom Matlab scripts to obtain bearings to the sound source. Matlab scripts rely upon custom Matlab code (BSM - Australian Antarctic Division) Greenridge Science's DIFAR Demultiplexer, Mark McDonald's DifarV software (www.whaleacoustics.com), sonobuoy deployment information, and measured receiver calibration information. Audio clips are processed with the maltab script difarWhales.m, and the user then confirms the audio clip was valid, and then selects the peak from the bearing-frequency-power surface (sometimes called the DIFAR bearing plot). The bearing and frequency at peak power are recorded in the log file, and then the bearing is plotted on the tracking map. Figure 6 shows a screenshot of the acoustic tracking software in action. The spectrogram and DIFAR bearing plot for the audio clip in this screenshot reveal strong noise, and in this instance, no DIFAR bearing could be obtained.

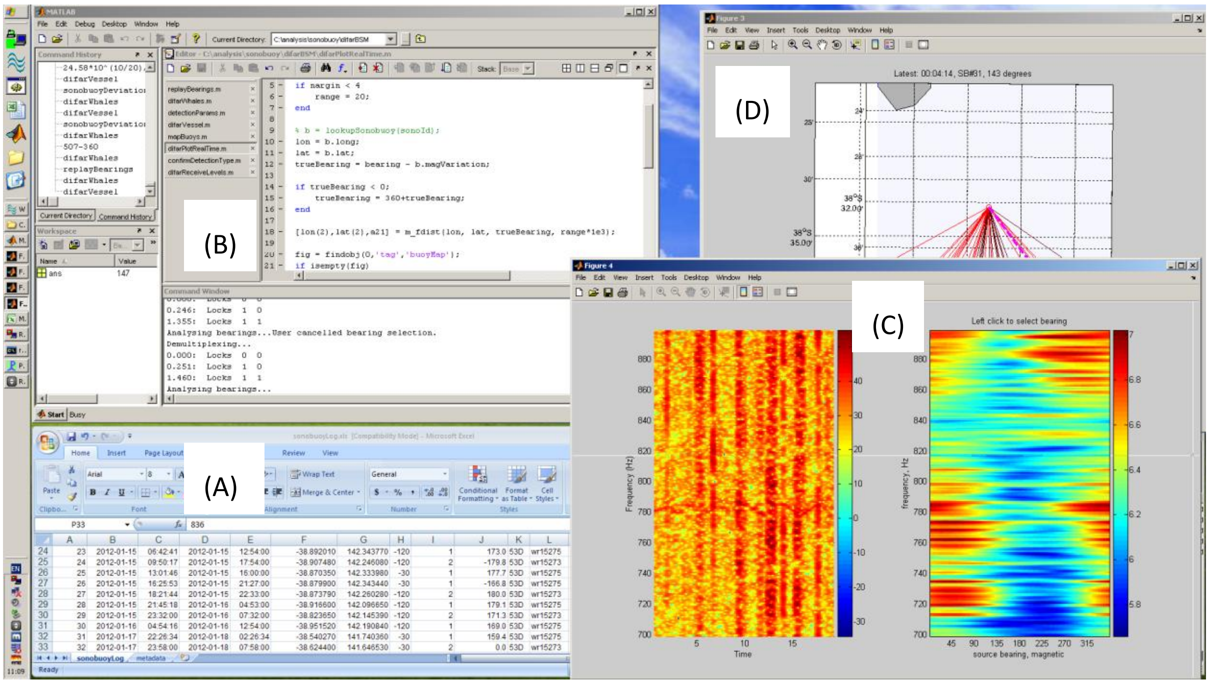


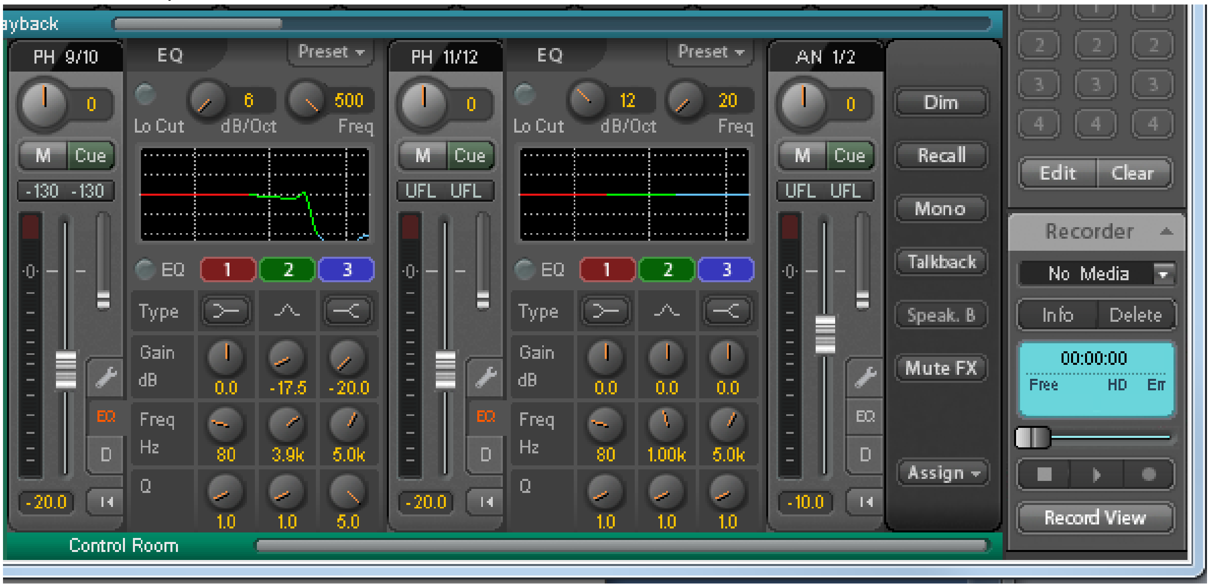
Figure 6 – Acoustic tracking screenshot showing (A) Sonobuoy deployment log file. (B) Matlab editior and command window for running acoustic tracking software. (C) Signal spectrogram and DIFAR bearing-frequency-power selection. (D) Map of acoustically derived bearings.

compass within the sonobuoy and the local magnetic anomaly are calculated as the vessel steams away from the sonobuoy after deployment. DIFAR bearings to the research vessel are subtracted from the measured bearing between the vessel GPS location and the GPS location of the sonobuoy deployment to obtain this correction factor.

15.6 Setting up the Fireface UFX and TotalMixFX

Plug Audio output of VHF receivers into MIC/LINE ports on the front of the Fireface UFX.
Set the gain for each MIC/LINE port in RME TotalMix FX to 20. Note down the gain setting as it is necessary for calibrated data.
Set each of the hardware inputs Mic 9 – 12 to mono and Instrument as shown below.

For monitoring, it is nice to set the HEADPHONE equaliser to filter out the pilot tones, as shown below for PH9/10.



15.7 Log files, notes, and other records

- All dates and times to be recorded as UTC unless otherwise specified.

Example Sonobuoy Log File and Explanation

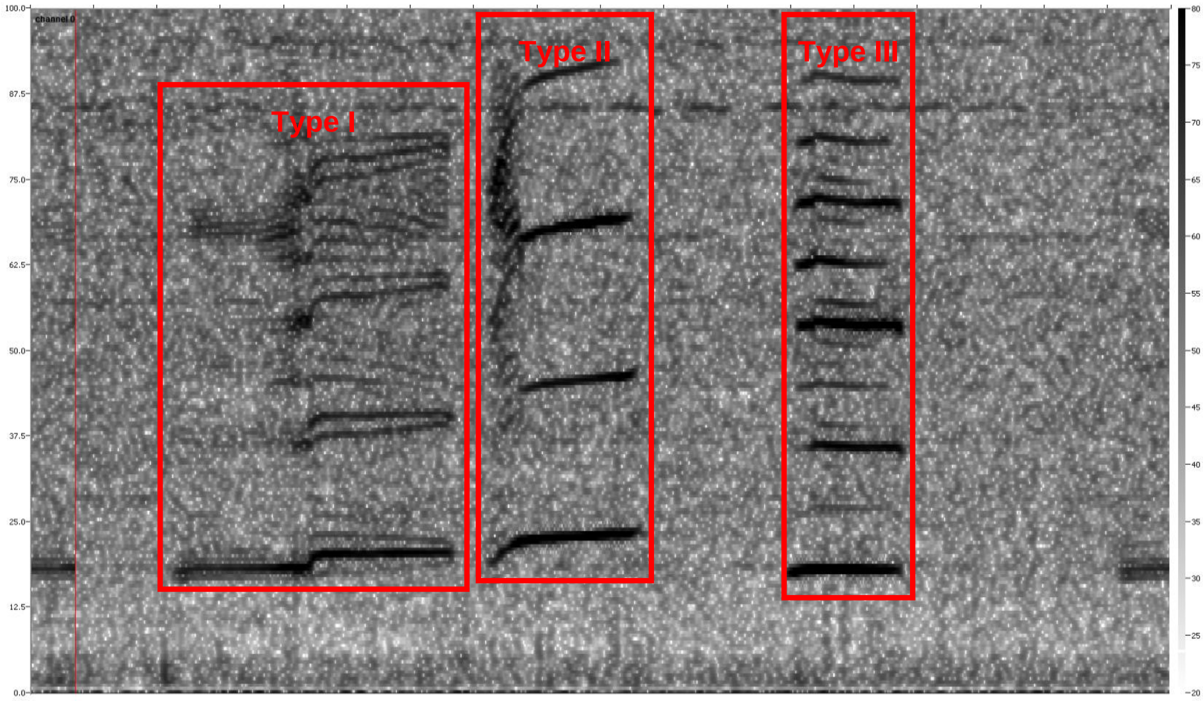
buoyID	startDate	startTime	stopDate	stopTime	lat	long	alt	recordingChannel	magVariation	sonobuoyType	receiver	preamp	adc	vhfFreq	waypoint
1	2012-01-07	05:56:31	2012-01-07	08:05:00	-38.464528	141.684306	-30	1	-186.8	53D	wr15275	10	ufx10	1	0
2	2012-01-07	06:56:00	2012-01-07	08:05:00	-38.490778	141.796472	-30	2	0.0	53D	wr17274	10	ufx10	6	807
3	2012-01-11	21:45:17	2012-01-11	22:49:00	-38.490960	141.540390	-30	1	-173.9	53D	wr15275	10	ufx10	80	808
4	2012-01-12	01:20:53	2012-01-12	02:17:00	-38.490830	141.036230	-120	1	175.8	53D	wr15275	10	ufx10	1	809

buoyID	Buoy ID number is the sequential number of the buoy starting at 1 for the first buoy of the trip*.
startDate	Date (UTC) at the start of the sonobuoy deployment (**YYYY-MM-DD**)
startTime	Time (UTC) at the start of the sonobuoy deployment (**HH:MM:SS**) 2 digit hour with 24 hour clock and leading zero.
stopDate	Date (UTC) at the end of the sonobuoy deployment (**YYYY-MM-DD**). While the recording is in progress this should be 1,2 4 or 8 hours after the startTime based on sonobuoy setting.
stopTime	Time (UTC) at the end of the sonobuoy deployment (**HH:MM:SS**). While the recording is in progress this should be 1,2 4 or 8 hours after the startTime based on the sonobuoy setting.
lat	Latitude of deployment in **decimal degrees.** Southern hemisphere latitudes should be negative.
long	Longitude of deployment in **decimal degrees.** Western hemisphere longitudes should be negative.
alt	Depth of the sonobuoy deployment in **metres**. For DIFAR sonobuoys either 30, 120 or 300.
recordingChannel	This is the channel number within the recorded **wav-file** that contains audio from this buoy as would be reported by **Matlab**. Channel numbers start at 1 (**1-indexed**) so usually this will be 1, 2 or 3.
magVariation	The magnetic variation in degrees. Positive declination is East, negative is West. At the start of a recording this will be entered from a chart. As the recording progresses, this should be updated by measuring the bearing to the vessel.
sonobuoyType	The an/ssq designation for the sonobuoy. Usually 53B, 53D, 53F, 57A/B, or 36Q.
receiver	The type and serial number of the radio receiver used to receive the VHF signal. (wr15725, wr17274, wr15274, or wr15273)
preamp	The gain in dB of any preamplifier (including the instrument preamp from the Fireface UFX). Usually 10 dB.
adc	The analog-to-digital converter (adc) used to digitize the audio. This is the sound card name and gain. Usually ufx10.

* The acoustic tracking software does not allow for a sonobuoy deployment to be non-continuous, and it also requires temporally overlapping deployments to have different channel numbers, so if a sonobuoy that was previously active is to be reinstated on a new recording channel in Pamguard, it must be given a new deployment number (eg. sonobuoys #39/41 and #54/56).

15.8 Terminology

For the most part, pygmy blue whale calls were referred to as song when describing stereotyped elements that were repeated at regular intervals. The figure below shows 3 unit song, comprised of type I, type II, and type III vocalisations. The 3 unit song almost always had the same order and a repetition rate of three to four minutes. In addition to 3 unit song, there was a 2 unit song that consisted of type II and type III calls repeated approximately every 80 s.



Aside from song, one other broad type of call was also tracked and attributed to blue whales. These calls were typically only one to a few seconds in duration and were usually frequency modulated sweeps spanning a few dozen Hz in the range of 20 – 120 Hz. Such calls have been detected in the presence of blue whales off of western North America, Antarctica, and the Perth Canyon in Western Australia, and are referred to in the literature as D calls. D calls have been recorded in the presence of blue whales worldwide. The figure below shows D calls as well as various types of noises including vessel noise, and noise from poor VHF radio reception.

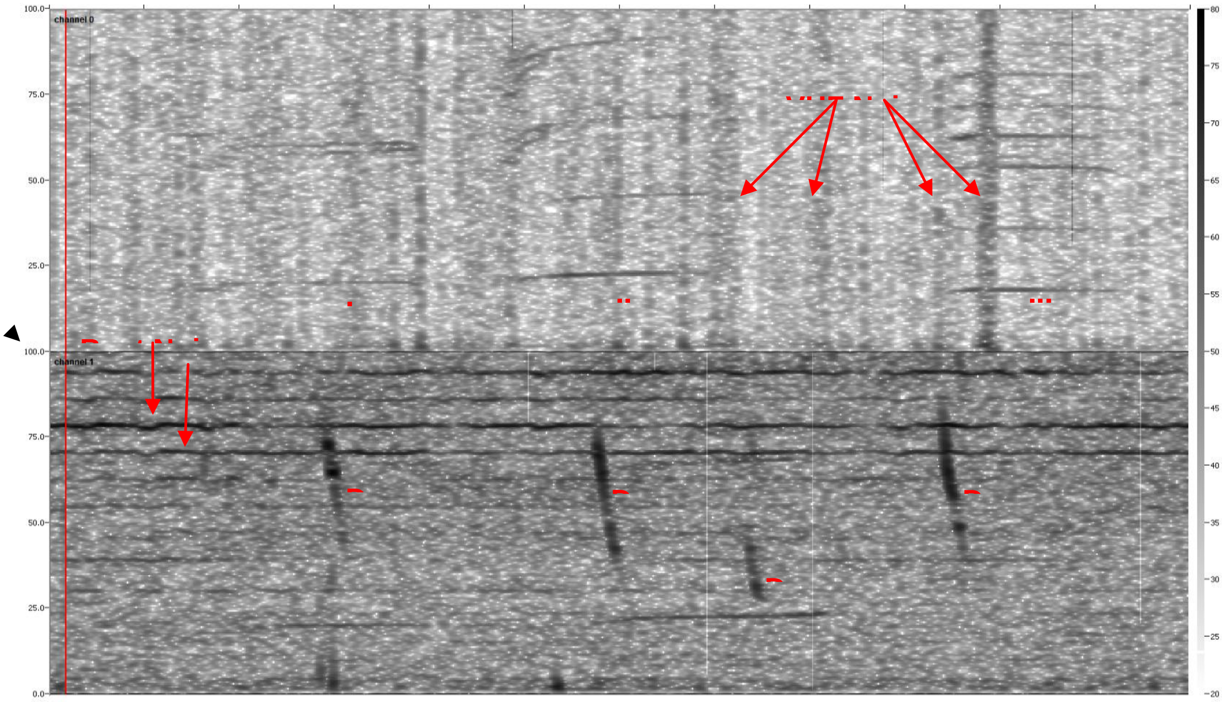
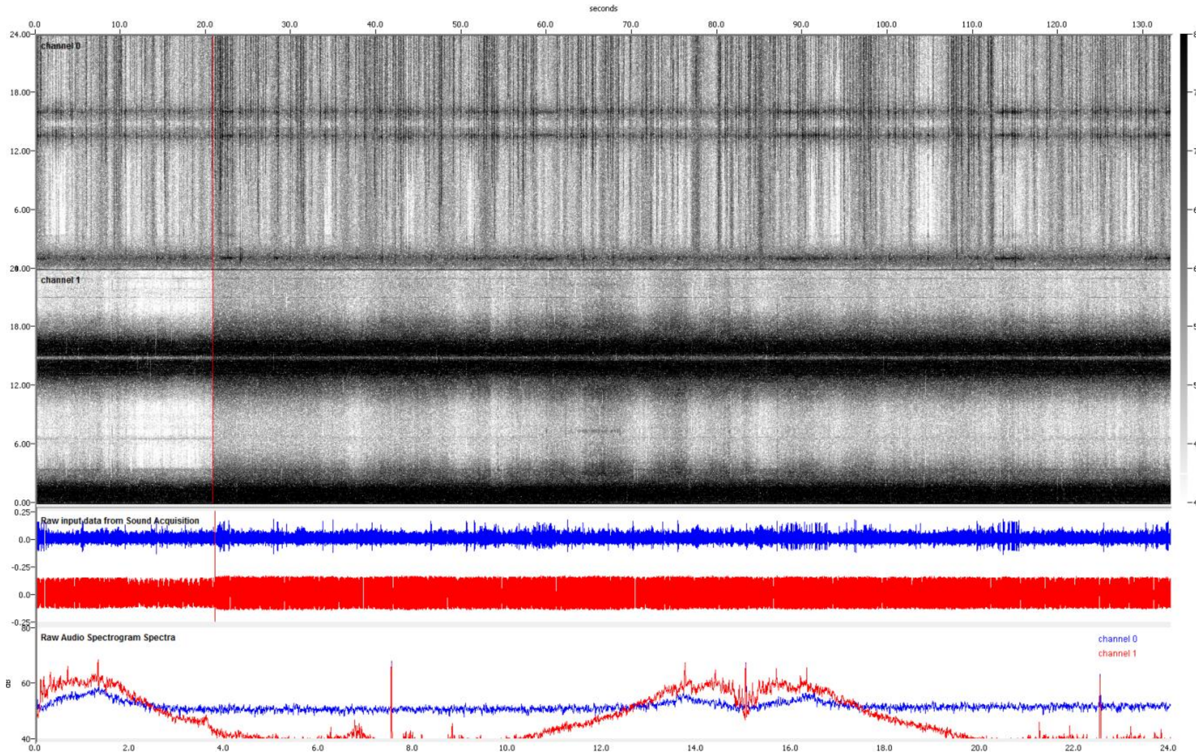


Figure 7 – Spectrogram from Pamguard showing various signal and noise types from two different sonobuoys. The top spectrogram shows weak 3 unit song in strong VHF noise. Song units are labelled I, II, and III. VHF noise appears as vertical bands of up to a few seconds in duration in the spectrogram. The bottom spectrogram shows moderate and strong D calls with weak type I and II calls barely visible in strong boat noise.

The end of VHF reception range was said to occur when the noise floor exceeded the DIFAR pilot tones. The figure below shows spectrograms, waveforms, and spectra of audio from two different sonobuoys. The DIFAR pilot tones and sidebands can be seen around 15 kHz in both channels, however channel 0 shows lots of intermittent broadband noise associated with poor VHF reception due to the sonobuoy being very distant. The channel 1 shows good VHF reception, and a strong DIFAR signal. The difference in the signal is also apparent when looking at the spectra.



DIFAR directional signals (sidelobes around the 15 kHz pilot tone) degrade more quickly than the DIFAR omnidirectional signal (at baseband), so sometimes it was possible to hear a whale but not obtain a bearing. Additionally, the RSSI (as reported by the WinRadio Sonobuoy software) was monitored, and signal was typically unusable when the RSSI was below 20 dB.
Whales that were being actively tracked and chased were called the target whale (denoted by T in the written notes). After finishing the acoustic tracking of the target whale, that whale became the previous target (PT). If two whales were vocalising, the non-target whale was sometimes referred to as the next target (NT).

During night time, the tracking protocol was somewhat different since there could be no visual verification of target whales during the night. Instead, the goal was to obtain crossbearings to whales in order to track them precisely so that the source level of the calls could be obtained.