CCAMLR

Commission for the Conservation of Antarctic Marine Living Resources
Commission pour la conservation de la faune et la flore marines de l'Antarctique
Комиссия по сохранению морских живых ресурсов Антарктики
Comisión para la Conservación de los Recursos Vivos Marinos Antárticos

WG-EMM-18/12

21 June 2018

Original: English

WG-EMM

Acoustic manual for the krill synoptic survey in 2019

G. Macaulay, G. Skaret, T. Knutsen, O.A. Bergstad and B.A. Krafft

EN

Acoustic manual for the krill synoptic survey in 2019

Macaulay G, Skaret G, Knutsen T, Bergstad OA, Krafft BA

Abstract

The previously presented document at the 2018 ASAM WG meeting (ASAM-18-07) described a design and plans for a synoptic krill acoustic survey in CCAMLR area 48 in 2019. The survey involves the collaborative efforts of Norway, Association of Responsible Krill fishing companies (ARK: companies from Norway, Korea, China and Chile), the United Kingdom, Ukraine, Korea and China, all of whom have confirmed a commitment of survey ship time. With these commitments it is feasible to implement all transects occupied during the 2000 survey. This document is a draft survey manual, produced at the recommendation of the 2018 ASAM meeting, and describes acoustic procedures, acoustic reporting - analysis procedures and contingency plans.

Contents

Introduction

This document is the manual for the vessels and people conducting the 2019 synoptic krill acoustic survey in CCAMLR area 48.

The SG-ASAM-18 Report recommended that the 2019 synoptic krill Survey Coordination Group prepare a survey manual for presentation at the 2018 WG-EMM meeting, and it should include acoustic procedures, survey design, analysis procedures and contingencies for different levels of available vessel effort. More specific recommendations were also given (paragraphs 5.12–5.14) and these are also covered in this manual.

The provisional membership of the Survey Coordination Group is given in Table 1.

Table 1. Membership of the Survey Coordination Group. * indicates not yet confirmed

Country/Organisation	**Representative**	**Contact details**
ARK/Aker	*Olav Rune Godø	olgo@norceresearch.no
Australia	*Martin Cox	martin.cox@aad.gov.au
China	Xianyong Zhao	zhaoxy@ysfri.ac.cn
Korea	Seok-Gwan Choi	sgchoi@korea.kr
Norway	Bjørn A. Krafft Georg Skaret Gavin Macaulay Tor Knutsen	bjorn.krafft@imr.no georg.skaret@imr.no gavin.macaulay@imr.no tor.knutsen@imr.no
Ukraine	Konstiantyn Demianenko	s_erinaco@ukr.net
United Kingdom	Sophie Fielding Simeon Hill	sof@bas.ac.uk sih@bas.ac.uk

Survey Design

Using the 2000 acoustic krill survey as a template, the nations and industry partners have made commitments to survey specific sets of transects or subareas. The survey will involve the collaborative efforts of Norway, Association of Responsible Krill fishing companies (ARK: companies from Norway, Korea, China and Chile), United Kingdom, Ukraine, Korea and China who have confirmed commitments (Table 2). With these commitments it is feasible to sample all transects occupied during the 2000 survey.

The industry partner contributions comprise 35 survey days from ARK members and an additional 6 days from AKER Biomarine. ARK dedicates FV *Cabo de Hornos* or FV *Juvel* for the survey and the same vessel will be used for the 7 additional Aker days. The industry has been attentive to the need for consistency and ease of operations and has thus committed a single rather than multiple vessels.

The RV Kronprins Haakon (KPH) will be allocated for the coverage by Norway for circa 29.5 days (the KPH will start the cruise in Punta Arenas, Chile and end in Stanley, Falkland Islands for a total of 46 days – the remaining days are for FBM related work). Korea will contribute with FV Kwangjaho for 10 days surveying near the South Shetland Islands, the United Kingdom will carry out the Western Core Box transects north of South Georgia with RRS Discovery (4 days), and Ukraine will contribute 5 days near South Sandwich Islands with the FV More Sodruzhestva, China will contribute 7 days of transects with the FV Fu Rong Hai and FV Long Teng; area coverage will be decided shortly. Vessels are allocated transects to

complete – the current allocation is shown in

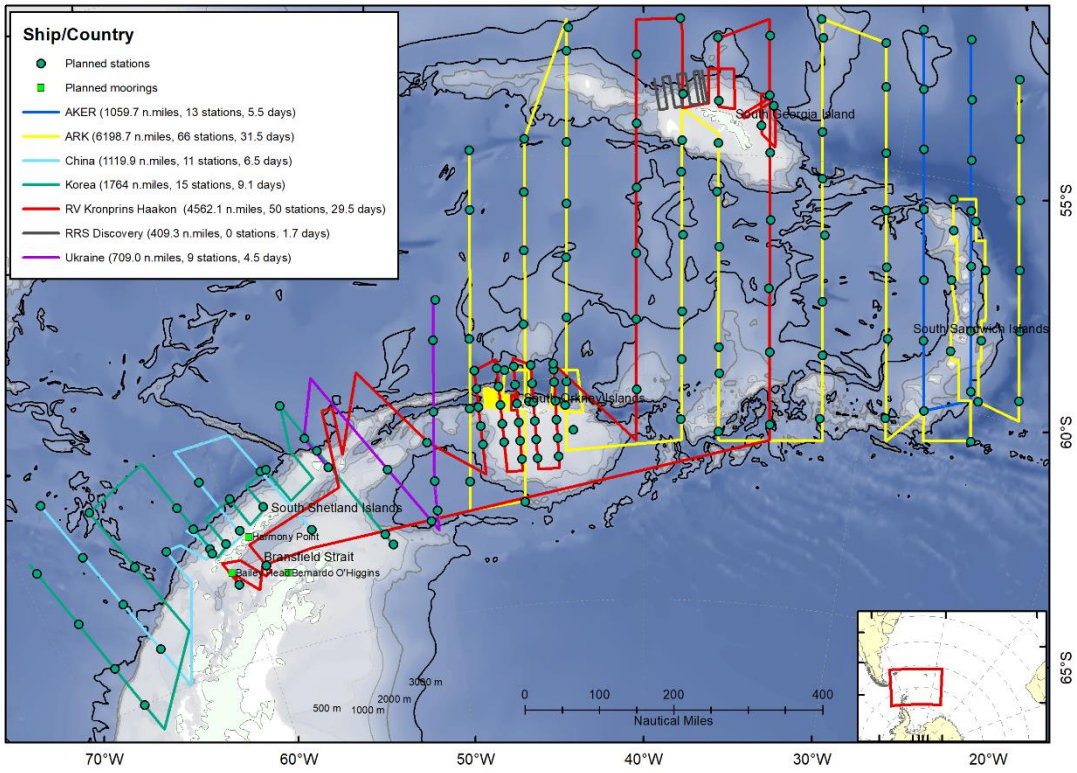

Figure 1.

SG-ASAM recommended that consideration be given to doing survey work in current krill fishing areas and to repeating the AMLR transects. We note that the Norwegian vessel is scheduled to spend circa 10 days in the Bransfield Strait area to support Feedback Management investigations and will occupy some of the AMLR transects while there. We also note that the USA intends to cover the AMLR transects using autonomous vehicles in the 2018/2019 Austral summer.

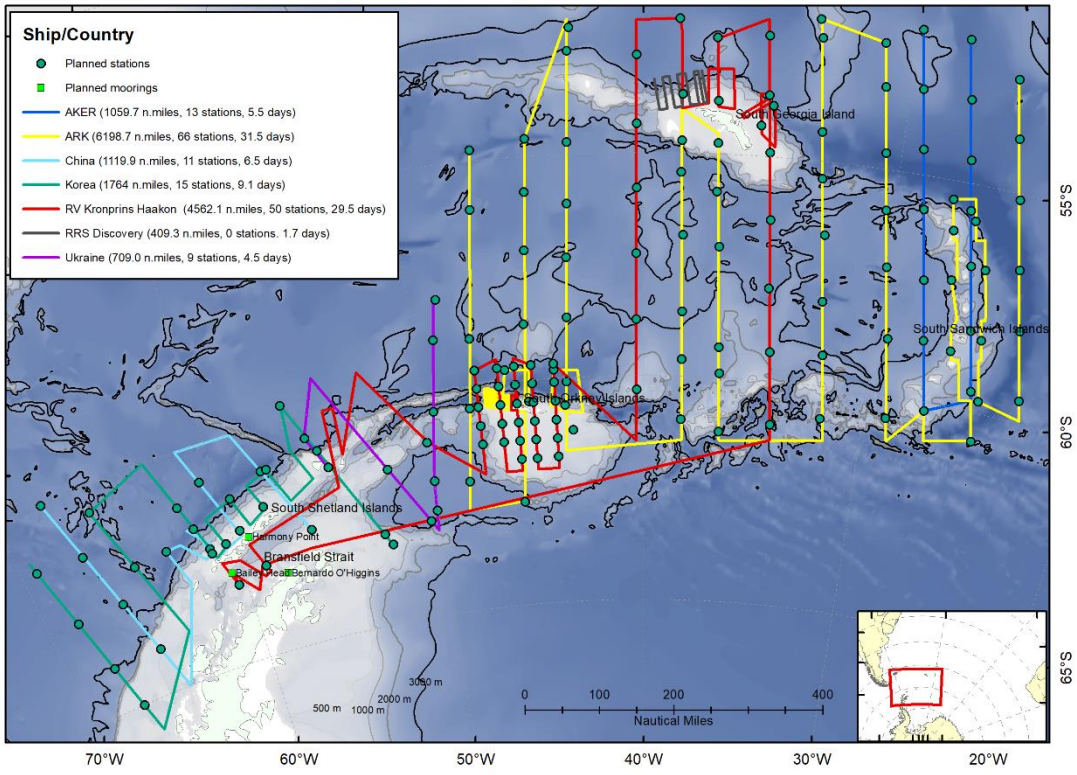

Figure 1. Full coverage of the transect lines from the CCAMLR 2000 survey lines with confirmed participation. The coverage is based on 9 knot cruising speed and an average on station time of 4 hours for research vessels (comprising vertical CTD casts, plankton nets and trawling) and 2 hours for fishing vessels (comprising a trawl station with CTD mounted on the trawl).

Biological Procedures

The biological procedures are provided in a working document that will be presented separately to EMM.

Oceanographic Procedures

The oceanographic procedures are provided in a working document that will be presented separately to EMM.

Acoustic Procedures

The acoustic procedure manual was developed during the SG-ASAM 2018 meeting and is attached here as Appendix A.

The transects and their allocation to vessels is given in Appendix B.

Reporting Procedures

Each surveying vessel must report daily to Bjørn A. Krafft, preferably via email (bjorn.krafft@hi.no) the following information:

1. Position
2. Transects completed and in progress
3. Potential survey problems, delays, etc

Analysis Procedures

Following recommendations from SG-ASAM, the Survey Coordination Group will conduct a pre-survey meeting which will include work on a plan for carrying out the analysis of the survey data, along with a timeline of expected analysis products.

Contingency plans

The 2019 synoptic krill survey is an international coordinated survey, utilizing 7 ships, contributing from 4 to 42 days each for a total of 87 days of survey time (Table 2). The survey objectives can be compromised if some of the survey effort cannot be realised. Table 3 presents an assessment of this risk and Table 4 presents actions that will be taken if survey effort reduces. One vessel will carry out almost half of the survey effort (from ARK and Aker, Table 2), and a second vessel a quarter of the effort (from Norway).

There are 98 days of ship time available for the survey (Table 2). Under optimal conditions, the survey is estimated to take 88.3 days at a ship speed of 9 knots, giving a contingency of 10.7 days. Based on earlier fishing vessels surveys, it is expected that the per station time will reduce below the allocated 2 hours, particularly for the ARK/Aker vessel. For the 77 stations allocated to this vessel, this can result in significant additional contingency time.

If vessels complete their transects with time to spare, that time will be used to cover transects that other vessels may not be able to complete, but otherwise to repeat transects, to gain temporal coverage.

Vessels that lack the required equipment through breakdowns, etc, will be allocated less prioritized survey areas (such as subarea 48.3).

Direction on reallocation of effort will be made by the Survey Coordination Group, as required during the survey period.

Table 2. Confirmed participation in the 2019 krill synoptic survey.

Entity	Confirmed surveys effort (days)	Days allocated to survey (buffer days)	Planned survey period (2019)	Comment
Norway	30	29.5 (0.5)	13.01-28.02	RV *Kronprins Haakon*
ARK	35	31.5 (4.5)	08.01-11.02	Particular vessel not yet confirmed
Aker	7	5.5 (1.5)	12.02-18.02	Potentially the same vessel as from ARK
Korea	10	9.1 (0.9)	Late Feb/early Mar	FV *Kwangjaho*
China	7	6.5 (0.5)	01.02-15.02	FV *Fu Rong Hai* and FV *Long Teng*
Ukraine	5	4.5 (0.5)	Early Dec 2018	FV *More Sodruzhestva*
United Kingdom	4	1.7 (2.3)	Early Jan	RRS *Discovery*
Total	98	88.3 (10.7)		

Table 3. Risk assessment of 2019 synoptic krill survey. Likelihood categories are: unlikely, seldom, occasional, likely, definite. Severity categories are: insignificant, minor, moderate, critical, catastrophic.

Risk	Likelihood	Severity	Comment
Loss of ship time due to bad weather	Definite	Minor	Available survey time allowance of 11% for bad weather. For loss of more time than this, see Table 4.
Loss of survey coverage due to ice	Occasional	Minor	Severity depends on extent of ice coverage. If minor, transects can be shifted. If major, survey coverage will suffer.
Loss of ship time due to ship unavailability	Occasional	Critical	Severity depends on number of days lost. See Table 4.
Failure of 38 and/or 120 kHz echosounder	Seldom	Critical	Severity depends on number of days lost See Table 4.
Failure of trawl/net equipment	Seldom	Moderate	All ships have the ability to repair trawl equipment and some (RV) also have spare trawls/nets onboard.
Survey outside of defined synoptic period	Likely	Moderate	Surveys outside the synoptic period cannot be used as part of the synoptic survey. Reduce survey coverage and ensure non-synoptic areas are repeated during the synoptic survey.
Failure of oceanographic equipment	Unlikely	Minor	Oceanographic measurements are not critical to survey outcome.

Table 4. Planned survey adjustments due to loss of ship time. The planned responses are general and actual loses and responses will depend on the exact nature of the loss of ship time.

Ship time lost (days)	Action	Consequence
5	Option 1: Prioritise acoustic operations over trawling and oceanographic Option 2: Remove individual transects, but keep survey extent	Trawling and oceanographic activities use little time, so only small amounts of time can be gained. Removing individual transects will likely increase the survey CV.
10-20	Reduce survey coverage in the eastern part of the survey area and around the South Sandwich Islands.	Fishing activity is very low in subarea 48.3 and considered to be a less important krill area.

> 20	Change survey focus to a smaller area	Wide area survey is no longer feasible. Change focus to the annual small-scale coverage of Areas 48.1 (AMLR transects), 48.2 (IMR transects) and 48.3 (BAS transects)

Appendix A: Acoustic Sampling Protocols

The following protocols are set for the purpose of standardizing acoustic data collection and archival from multiple-ships during the multi-national effort to synoptically survey the entirety of Area 48 during the austral summer of 2018/2019. Methods for data analysis are not considered here, rather the primary objective of these protocols is to make the data collections as comprehensive and uniform as possible across all research platforms. Whenever possible, exact equipment, software, and settings have been dictated. In the cases where exact matches are not possible, pertinent comparative information has been specified.

Echosounder

The following echosounder models are acceptable to use:

- Simrad EK60. Software version ER60 2.4.3
- Simrad EK80. Software version EK80 1.12.1 (a more recent version will be available before the survey and this will most likely be recommended)
- Simrad ES70. Software version ES70 1.2.1 (it is strongly preferred that the EK80/ES80 software be used to control the GPT instead, as this avoids the triangle wave error present in ES70 data). However, it is acknowledged that moving to EK80/ES80 software requires a more powerful computer to run the software and that this may not be feasible.

Transducers

Preferred transducer model have a 7° conical beamwidths that allow approximately equivalent insonified volumes.

38 kHz: Simrad split-beam (e.g. ES38-7, ES38B)
70 kHz: Simrad split-beam (e.g. ES70-7C)
120 kHz: Simrad split-beam (e.g. ES120-7, ES120-7C)
200 kHz: Simrad split-beam (e.g. ES200-7, ES200-7C)

Single-beam transducers at the same frequencies are acceptable if there is at least one split-beam transducer co-located with the single-beam transducer to allow for efficient calibration of the single-beam transducer.

Transducers with beamwidths other than 7° may be acceptable. However, using a standard 7° conical beam width would ensure approximately equivalent insonified volumes. This will be advantageous for employing multi-frequency methods for swarm delineation.

Mounting configuration should be documented by scaled technical diagrams, suitable for positioning them on both the alongship and athwarship axes. Record should be made of blister, or trunk dimensions and location on hull; acoustic window material and acoustic properties; and the transducer depths, dimensions and relative locations.

The transducers should be mounted as close to each other as possible.

Settings

Echosounder settings files should be agreed upon and used by all survey participants for the survey, calibration, and noise measurement operations; only settings determined by individual system calibrations might differ (e.g. gain, Sa correction, beam angles, transducer depth).

Before the initial calibration experiments, critical system specific settings should be updated following Table 2 in the appendix and specifications and should not be changed. Compliance with the prescribed settings should be checked daily.

Particularly Notable Settings:

- For EK80/ES80: use single-frequency pulses (CW not FM)
- For EK80/ES80 the pulse slope must be set to 'Fast'
- A pulse repetition rate of 2.0 seconds will be used for survey and noise measurements. Faster, 0.5 seconds should be appropriate for calibration.
- Pulse durations of 1.024 ms will be transmitted at all three frequencies.
- The transducer depths will be set to the nominal mounting depths for each transducer.
- A mean sound speed and mean absorption coefficient will be provided; all echosounders will be set using these values. Note a CTD prior to calibration will be used to set these values during calibration, but the mean values should be used for the survey and noise measurements.
- Data for each ping and frequency will be recorded at 0-1100 m for EK60 and ES70 and for EK80/ES80 within the following ranges:
    - 38 kHz: 0-1100 m
    - 70 kHz: 0-1100 m
    - 120 kHz: 0-500 m
    - 200 kHz: 0-300 m
- Echosounder time should be reset to correspond with logging PC/GPS time at the start of each day's survey at a minimum – or synchronised to the ships GPS network clock using appropriate software (is there any generic).
- Echosounder computer time must be within 5 seconds of the GPS time.
- Time must be entered in UTC, which needs to be used as the only time for all logging and sampling procedures aboard. The use of UTC should be cross-checked among the acoustic, biological and oceanographic components of the cruise.
- The log menu/distance will be set only once to 0.0 n.mi. at the end of the initial calibration.

Data Logging

- Data must be logged continuously in .raw format into dedicated hard drives
- A daily backup must be carried out (e.g., on to a second external hard drive or network server)
- Data discs can be provided by IMR, on request

System Calibration: standard sphere calibrations

- Ideally system calibrations will be performed at all frequencies immediately before and after the survey in appropriate locations. However, a single calibration at appropriate sites within the study area is acceptable. Suitable locations should be free from strong freshwater input. Good examples of suitable locations within the study area include Rosita Harbour and Stromness Bay, South Georgia, Scotia Bay, South Orkney, and Admiralty Bay, King George Island.
- Sphere calibration must follow ICES CRR 326 standard procedures (Demer et al., 2015). Some particular issues to be highlighted:
    - If at all possible, the transducer faces must be cleaned of debris and bio-fouling prior to the initial calibration.
    - During the entirety of both pre- and post-survey calibration experiments, all acoustic data will be logged in .raw files.

- Record must be made of the calibration: date; time; location; sea state (swell, wind, currents, ice); water temperature profile; salinity profile; sound speed profile; bottom depth; calibration apparatus; and ship's mooring configuration.
- The 38.1 mm WC sphere must be used as the standard target. If possible, spheres will be purchased from a single production batch and provided to all parties by the Norwegian Institute of Marine Research (IMR).
- A calibration rig can be borrowed from another nation or the Association of Responsible Krill harvesting companies (ARK)
- Theoretical TS=f(bandwidth and sound speed) will be provided (Table 1) for the EK60 and ES70. For the EK80, the sphere material properties are entered into the EK80 calibration program.
- The calibration parameters should be estimated using the echosounder software of either the ER60 (for EK60 and ES60) or the EK80 (for ES70 and EK80).
- It is recommended to update calibration parameters before running the survey

System check

Echosounder operation checks must be carried out daily. These checks are to include:

- Examination of the spatial distribution of single target detections to check for abnormal distributions,
- For the ES80/EK80, use of the BITE view to monitor the transducer impedance,
- Inspection of the background noise level as reported by the echosounder software

If feasible, the use of the seabed echo amplitude as an echosounder operation check is encouraged.

Pre-cruise characterization of system noise

A pre-cruise background noise characterization is required before the cruise in order to establish a baseline noise level and identify the speed at which appropriate quality data is collected. In order to do this we require data to be collected in passive or active mode, using prescribed settings (Table 2) in water depth greater than 50 m (in passive mode) or greater than 300 m (in active mode). Data collected should cover a range of speeds. Ideally 15 minutes per 6 knots, 7 knots, 8 knots, 9 knots, 10 knots, 11 knots and 12 knots.

Survey Operations

Whenever possible, survey at a constant speed of 10 knots (or as instructed from pre-cruise characterisation of system noise - see above); acoustic noise perceived by each of the echosounder frequencies will be routinely monitored and speed adjusted if needed to reduce noise or increasing speed to maintain schedule as needed (provided noise level is acceptable).

Necessary Preliminary Investigations

Bench test echosounder using chosen settings and logging options.

Metadata logging

Metadata must be logged according to ICES (2016), trawl metadata will be recorded as part of the trawl station work and catch recording. Logging of environmental data should follow Table 3. Acoustic metadata is automatically recorded by the echosounders.

A survey log must be kept. This log must include these items:

- Start and stop times and positions of transects
- Times and positions of other survey activities (e.g., trawls, oceanographic stations, calibrations)
- Other items of note that are relevant to the survey, such as diversion of vessel from transects, reasons for doing so, equipment problems, etc.

References

Demer, D. A. (2004). "An estimate of error for the CCAMLR 2000 survey estimate of krill biomass." Deep-Sea Research II 51: 1237-1251.

Demer, D. A., Berger, L., Bernasconi, M., Boswell, K. M., Chu, D., Domokos, R., Dunford, A. J., *et al.* 2015. Calibration of acoustic instruments. ICES Cooperative Research Report No. 326, ICES 326. 130 pp.

ICES. 2016. A metadata convention for processed acoustic data from active acoustic systems. Series of ICES Survey Protocols SISP 4-TG-AcMeta. 48 pp.

Krafft BA, Bergstad OA, Knutsen T, Skaret G, Macauley G. 2018. Multinational large-scale krill synoptic survey in CCAMLR Area 48 in 2019 – survey plan and protocol for consideration by SG-ASAM 2018. SG-ASAM-18/07. 8 pp.

Observing Handbook No. 1 (2010). National Weather Service. Marine Surface Weather Observations. May 2010. U.S. DEPARTMENT OF COMMERCE

Table 1. Calibration sphere target strength values

Sphere diameter = 38.1 mm
Sphere density = 14900 kg/m^3
Sphere compressional sound speed = 6864 m/s
Sphere shear sound speed = 4161.2 m/s
Water density = 1025.3288 kg/m^3
Pulse duration = 1.024 ms

Sound speed (m/s)	Sphere TS at 38 kHz	Sphere TS at 70 kHz	Sphere TS at 120 kHz	Sphere TS at 200 kHz
1450	-42.01	-40.56	-39.84	-39.44
1455	-42.06	-40.65	-39.76	-39.48
1460	-42.11	-40.74	-39.69	-39.50
1465	-42.16	-40.83	-39.63	-39.50
1470	-42.20	-40.92	-39.58	-39.48
1475	-42.23	-41.01	-39.54	-39.44
1480	-42.26	-41.09	-39.52	-39.38
1485	-42.29	-41.18	-39.5	-39.30
1490	-42.31	-41.25	-39.51	-39.22
1495	-42.32	-41.33	-39.52	-39.13
1500	-42.33	-41.39	-39.55	-39.04
1505	-42.33	-41.45	-39.59	-38.96
1510	-42.33	-41.50	-39.63	-38.90
1515	-42.33	-41.54	-39.69	-38.85
1520	-42.32	-41.57	-39.76	-38.81

Table 2. Echo sounder settings

Parameter	Value	Comment
Pulse duration	1.024 ms	
Transmit power	38 kHz: 2000 W 70 kHz: 750 W 120 kHz: 250 W 200 kHz: 150 W	The selectable values differ slightly between the EK60/ES70 and EK80/ES80. Choose the closest value that is equal to or less than the given values.
Pulse slope	Fast	Only applicable to ES80/EK80 systems.
Ping interval	2.0 s	
Vessel speed	8-10 knots	Subject to sufficiently low noise levels.
Sound speed	1456 m/s	Obtained from Table 1 of Demer (2004), derived from Scotia Sea measurements.
Absorption coefficient	38 kHz: 10.4 dB/km 70 kHz: 18.9 dB/km 120 kHz: 27.7 dB/km 200 kHz: 41.3 dB/km	Obtained from Table 1 of Demer (2004), derived from Scotia Sea measurements. 70 kHz value derived from weighted harmonic mean temperature and salinity values from the same table.
Data recording depth	38 kHz: 1100 m 70 kHz: 1100 m 120 kHz: 500 m 200 kHz: 300 m	For EK60/ES70 systems use 1100 m for all frequencies.

Pulse type	CW	Only applicable to ES80/EK80 systems.

Table 3. Environmental data to be recorded

These are to be collected 4 times daily (00:00, 06:00, 12:00, 18:00 UTC) as per the WMO Voluntary Observing Ships Scheme, following guidelines provided in the USA National Weather Service Observing Handbook No. 1 (2010).

Wind speed	
Wind direction	
Sea state	
Ice conditions	
Ice cover	
Cloud cover	
Air temperature	
Dew point	

Appendix B: Transect allocation

The survey transects and their allocation to vessels is given in Table B.1. This is subject to revision up to and during the survey.

Nation	Area	TransectCode	Position	Longitude	Latitude
Kronprins Haakon	AP	AP11	1	-52.6801	-59.3151
Kronprins Haakon	AP	AP11	2	-49.9883	-61.1299
Ukraine	AP	AP12	1	-54.6640	-59.2367
Ukraine	AP	AP12	2	-50.1206	-63.1002
Korea	AP	AP13	1	-56.2474	-59.6747
Korea	AP	AP13x	2	-54.8800	-61.0700
Korea	AP	AP13	3	-52.5044	-63.2340
China	AP	AP14	1	-58.8083	-60.0026
China	AP	AP14	2	-56.2283	-62.5221
China	AP	AP15	1	-61.3638	-60.0067
China	AP	AP15X	2	-59.5500	-62.2300
Kronprins Haakon	AP	AP15X	3	-59.3500	-62.4800
Kronprins Haakon	AP	AP15	4	-58.7032	-63.1719
Korea	AP	AP16	1	-62.9254	-60.0054
Korea	AP	AP16X	2	-61.0000	-62.5400
Kronprins Haakon	AP	AP16Y	1	-60.8800	-62.6900
Kronprins Haakon	AP	AP16Y	2	-60.3995	-63.2615
Korea	AP	AP17	1	-65.9351	-60.6042
Korea	AP	AP17	2	-63.5449	-63.8507
China	AP	AP18	1	-67.8326	-60.0088
China	AP	AP18	2	-64.5037	-64.9975
Korea	AP	AP19	1	-69.4142	-61.0985
Korea	AP	AP19	2	-66.7392	-65.6797
Kronprins Haakon	SubArea_48_1	SA_481_T13	1	-54.5000	-60.0000
Kronprins Haakon	SubArea_48_1	SA_481_T13	2	-54.5000	-61.7500
Kronprins Haakon	SubArea_48_1	SA_481_T14	1	-54.0000	-60.0000
Kronprins Haakon	SubArea_48_1	SA_481_T14	2	-54.0000	-61.0500
Kronprins Haakon	SubArea_48_1	SA_481_T16	1	-60.5000	-63.0000
Kronprins Haakon	SubArea_48_1	SA_481_T16	2	-59.5000	-63.5000
Kronprins Haakon	SubArea_48_1	SA_481_T17	1	-60.0000	-62.7500
Kronprins Haakon	SubArea_48_1	SA_481_T17	2	-59.0000	-63.2500
China	SubArea_48_1	SA_481_T2	1	-62.5000	-62.0000
China	SubArea_48_1	SA_481_T2	2	-61.5000	-62.5000
China	SubArea_48_1	SA_481_T3	1	-62.0000	-61.7500
China	SubArea_48_1	SA_481_T3	2	-61.0000	-62.2500

Kronprins Haakon	SubArea_48_2	SA_482_T3+SOF4	1	-46.5000	-59.4800
Kronprins Haakon	SubArea_48_2	SA_482_T3+SOF4	2	-46.5000	-59.6700
Kronprins Haakon	SubArea_48_2	SA_482_T4+SOF3	3	-45.7500	-59.6700
Kronprins Haakon	SubArea_48_2	SA_482_T4+SOF3	4	-45.7500	-59.4800
Kronprins Haakon	SubArea_48_3	SA_483_T10	1	-35.1633	-53.771
Kronprins Haakon	SubArea_48_3	SA_483_T10	2	-36.175	-54.1725
Kronprins Haakon	SubArea_48_3	SA_483_T9	1	-35.2532	-53.6915
Kronprins Haakon	SubArea_48_3	SA_483_T9	2	-36.2603	-54.0955
ARK	Sandwich	Sand01	1	-26.8688	-55.3278
ARK	Sandwich	Sand01	2	-26.5464	-56.2248
ARK	Sandwich	Sand02	1	-25.8413	-57.0615
ARK	Sandwich	Sand02	2	-26.1846	-56.1807
ARK	Sandwich	Sand03	1	-25.8341	-57.0589
ARK	Sandwich	Sand03	2	-25.4933	-57.9353
ARK	Sandwich	Sand04	1	-25.6677	-57.9539
ARK	Sandwich	Sand04	2	-25.3051	-58.8291
ARK	Sandwich	Sand05	1	-25.4162	-58.8438
ARK	Sandwich	Sand05	2	-25.0392	-59.7308
ARK	Sandwich	Sand06	1	-25.8934	-59.8135
ARK	Sandwich	Sand06	2	-26.2652	-58.9345
ARK	Sandwich	Sand07	1	-26.8504	-58.3053
ARK	Sandwich	Sand07	2	-26.5933	-58.9387
ARK	Sandwich	Sand08	1	-27.2322	-57.1982
ARK	Sandwich	Sand08	2	-26.6781	-58.0418
ARK	Sandwich	Sand09	1	-27.2950	-56.2969
ARK	Sandwich	Sand09	2	-27.0021	-57.1818
ARK	Sandwich	Sand10	1	-27.7425	-55.4193
ARK	Sandwich	Sand10	2	-27.4390	-56.3129
Kronprins Haakon	SouthGeorgia	SG01	1	-35.0017	-53.8762
Kronprins Haakon	SouthGeorgia	SG01	2	-34.8935	-54.7724
Kronprins Haakon	SouthGeorgia	SG02	1	-35.5918	-53.5924
Kronprins Haakon	SouthGeorgia	SG02	2	-35.4519	-54.4954
Kronprins Haakon	SouthGeorgia	SG03	1	-36.6512	-53.081
Kronprins Haakon	SouthGeorgia	SG03	2	-36.5431	-53.9778
Kronprins Haakon	SouthGeorgia	SG04	1	-37.5929	-53.1058
Kronprins Haakon	SouthGeorgia	SG04	2	-37.5314	-53.8659
ARK	SouthOrkneyConsentrated	SOC_01	1	-47.1750	-60.1000
ARK	SouthOrkneyConsentrated	SOC_01	2	-47.1750	-60.5000
ARK	SouthOrkneyConsentrated	SOC_02	1	-47.1500	-60.1000
ARK	SouthOrkneyConsentrated	SOC_02	2	-47.1500	-60.5000

ARK	SouthOrkneyConsentrated	SOC_03	1	-47.0500	-60.1000
ARK	SouthOrkneyConsentrated	SOC_03	2	-47.0500	-60.5000
ARK	SouthOrkneyConsentrated	SOC_04	1	-46.9500	-60.1000
ARK	SouthOrkneyConsentrated	SOC_04	2	-46.9500	-60.5000
ARK	SouthOrkneyConsentrated	SOC_05	1	-46.8500	-60.1500
ARK	SouthOrkneyConsentrated	SOC_05	2	-46.8500	-60.4500
ARK	SouthOrkneyConsentrated	SOC_06	1	-46.7500	-60.1500
ARK	SouthOrkneyConsentrated	SOC_06	2	-46.7500	-60.4500
ARK	SouthOrkneyConsentrated	SOC_07	1	-46.6750	-60.1500
ARK	SouthOrkneyConsentrated	SOC_07	2	-46.6750	-60.4500
ARK	SouthOrkneyConsentrated	SOC_08	1	-46.5500	-60.2000
ARK	SouthOrkneyConsentrated	SOC_08	2	-46.5500	-60.5500
ARK	XSouthOrkneyConsentrated	SOC_09-SOF_4	1	-46.5000	-60.2000
ARK	XSouthOrkneyConsentrated	SOC_09-SOF_4	2	-46.5000	-60.6000
ARK	SouthOrkneyConsentrated	SOC_10	1	-46.3750	-60.4500
ARK	SouthOrkneyConsentrated	SOC_11	1	-46.2500	-60.3000
ARK	SouthOrkneyConsentrated	SOC_11	2	-46.2500	-60.4500
ARK	SouthOrkneyConsentrated	SOC_12	1	-46.1750	-60.3000
ARK	SouthOrkneyConsentrated	SOC_12	2	-46.1750	-60.4500
ARK	SouthOrkneyConsentrated	SOC_13	1	-46.1000	-60.3000
ARK	SouthOrkneyConsentrated	SOC_13	2	-46.1000	-60.5500
Kronprins Haakon	SouthOrkneyConsentrated	SOC_14	1	-45.9750	-60.3000
Kronprins Haakon	SouthOrkneyConsentrated	SOC_14	2	-45.9750	-60.4500
Kronprins Haakon	SouthOrkneyConsentrated	SOC_15	1	-45.8250	-60.3000
Kronprins Haakon	SouthOrkneyConsentrated	SOC_15	2	-45.8250	-60.4500
Kronprins Haakon	SouthOrkneyConsentrated	SOC_16	1	-45.7750	-60.3000
Kronprins Haakon	SouthOrkneyConsentrated	SOC_16	2	-45.7750	-60.4500
Kronprins Haakon	SouthOrkneyConsentrated	SOC_17	1	-45.7000	-60.3000
Kronprins Haakon	SouthOrkneyConsentrated	SOC_17	2	-45.7000	-60.4500
Kronprins Haakon	SouthOrkneyFixed	SOF_1	1	-44.0000	-59.6667
Kronprins Haakon	SouthOrkneyFixed	SOF_1	2	-44.0000	-62.0000
Kronprins Haakon	SouthOrkneyFixed	SOF_2	1	-45.0000	-59.6667
Kronprins Haakon	SouthOrkneyFixed	SOF_2	2	-45.0000	-62.0000
Kronprins Haakon	SouthOrkneyFixed	SOF_3+SA_482_T4	1	-45.7500	-59.6667
Kronprins Haakon	SouthOrkneyFixed	SOF_3x	2	-45.7500	-60.5000
Kronprins Haakon	SouthOrkneyFixed	SOF_3yx	3	-46.0500	-60.6300
Kronprins Haakon	SouthOrkneyFixed	SOF_3y	4	-45.7500	-60.6500
Kronprins Haakon	SouthOrkneyFixed	SOF_3+SA_482_T4	5	-45.7500	-62.0000

Kronprins Haakon	SouthOrkneyFixed	SOF_4+SA_482_T 3	1	-46.5000	-59.6667
Kronprins Haakon	SouthOrkneyFixed	SOF_4+SA_482_T 3	2	-46.5000	-62.0000
Kronprins Haakon	SouthOrkneyFixed	SOF_5	1	-47.5000	-59.6667
Kronprins Haakon	SouthOrkneyFixed	SOF_5	2	-47.5000	-62.0000
ARK	SouthOrkney	SOI01	1	-42.9324	-59.8405
ARK	SouthOrkney	SOI01	2	-42.7716	-60.7934
ARK	SouthOrkney	SOI02	1	-43.9815	-59.8114
ARK	SouthOrkney	SOI02	2	-44.2464	-60.6104
ARK	SouthOrkney	SOI03	1	-45.0964	-59.7764
ARK	SouthOrkney	SOI03	2	-45.2073	-60.4928
ARK	SouthOrkney	SOI04	1	-46.1600	-59.7277
ARK	SouthOrkney	SOI04+SOC_10	2	-46.3781	-60.3548
ARK	SouthShetland	SS01_n101	1	-31.1543	-52.1865
ARK	SouthShetland	SS01	2	-30.9434	-53.1800
ARK	SouthShetland	SS01	3	-28.7944	-61.0001
ARK	SouthShetland	SS02	1	-33.5332	-51.8195
ARK	SouthShetland	SS02	2	-31.6907	-61.1981
Kronprins Haakon	SouthShetland	SS03	1	-35.4459	-51.9211
Kronprins Haakon	SouthShetland	SS03_302	2	-35.2543	-53.6215
Kronprins Haakon	SouthShetland	SS03_302	3	-35.2543	-53.6215
Kronprins Haakon	SouthShetland	SS03_303	4	-35.076	-54.9063
Kronprins Haakon	SouthShetland	SS03	5	-34.1383	-61.3160
Kronprins Haakon	SouthShetland	SS04	1	-37.2504	-52.4111
Kronprins Haakon	SouthShetland	SS04x	2	-37.24	-53.09
Kronprins Haakon	SouthShetland	SS04x	3	-37.15	-53.94
ARK	SouthShetland	SS04x	4	-37.1000	-54.5500
ARK	SouthShetland	SS04	5	-36.4890	-61.3978
Kronprins Haakon	SouthShetland	SS05n	1	-38.6800	-51.9883
Kronprins Haakon	SouthShetland	SS05	2	-38.5832	-52.3007
Kronprins Haakon	SouthShetland	SS05y	3	-38.5300	-54.0000
ARK	SouthShetland	SS05y	4	-38.5300	-54.0000
ARK	SouthShetland	SS05	5	-38.2419	-61.4192
Kronprins Haakon	SouthShetland	SS06	1	-40.2614	-52.0210
Kronprins Haakon	SouthShetland	SS06	2	-40.3376	-61.4397
ARK	SouthShetland	SS07	1	-42.7951	-51.9803
ARK	SouthShetland	SS07x	2	-43.5300	-60.7500
ARK	SouthShetland	SS07x	3	-43.5300	-60.7500
ARK	SouthShetland	SS07	4	-43.6219	-61.6194
ARK	SouthShetland	SS08	1	-44.6071	-54.6030
ARK	SouthShetland	SS08x	2	-45.3800	-60.5400

ARK	SouthShetland	SS08y	1	-45.4100	-60.7000
ARK	SouthShetland	SS08	2	-45.7467	-62.6851
ARK	SouthShetland	SS09	1	-46.7482	-54.7406
ARK	SouthShetland	SS09	2	-48.4708	-62.7624
Ukraine	SouthShetland	SS10	1	-48.8980	-58.0052
Ukraine	SouthShetland	SS10x	2	-49.7500	-61.2100
Ukraine	SouthShetland	SS10	3	-49.9979	-62.0005
ARK	SouthShetland_abc	SSA	1	-26.1289	-52.5021
ARK	SouthShetland_abc	SSA	2	-23.0677	-59.9446
AKER	SouthShetland_abc	SSB	1	-28.1188	-51.8239
AKER	SouthShetland_abc	SSBx	2	-25.3700	-59.7500
ARK	SouthShetland_abc	SSBx	3	-25.3700	-59.7500
ARK	SouthShetland_abc	SSB	4	-24.9653	-60.6297
AKER	SouthShetland_abc	SSC	1	-29.8671	-51.7933
AKER	SouthShetland_abc	SSCx	2	-27.3352	-60.1882
ARK	SouthShetland_abc	SSCx	3	-27.3352	-60.1882
ARK	SouthShetland_abc	SSC	4	-27.1023	-60.8465
Ukraine	SouthShetlandIslands	SSI01	1	-55.5465	-60.5041
Ukraine	SouthShetlandIslands	SSI01	2	-54.7326	-61.3129
Korea	SouthShetlandIslands	SSI02	1	-56.3212	-60.6861
Korea	SouthShetlandIslands	SSI02	2	-55.5830	-61.4278
Korea	SouthShetlandIslands	SSI03	1	-57.6213	-60.9760
Korea	SouthShetlandIslands	SSI03	2	-56.8510	-61.7889
Korea	SouthShetlandIslands	SSI04	1	-58.6888	-61.2038
Korea	SouthShetlandIslands	SSI04	2	-58.1256	-61.8020
Korea	SouthShetlandIslands	SSI05	1	-59.6026	-61.3833
Korea	SouthShetlandIslands	SSI05	2	-59.0156	-62.0630
Korea	SouthShetlandIslands	SSI06	1	-60.9699	-61.6410
Korea	SouthShetlandIslands	SSI06	2	-60.3918	-62.3503
China	SouthShetlandIslands	SSI07	1	-61.6782	-61.7669
China	SouthShetlandIslands	SSI07	2	-61.0635	-62.5361
China	SouthShetlandIslands	SSI08	1	-63.2452	-62.0343
China	SouthShetlandIslands	SSI08	2	-62.6091	-62.8779
RRS Discovery	Western Core Box survey	WCB_01	1	-39.6026	-53.3458
RRS Discovery	Western Core Box survey	WCB_01	2	-39.3939	-54.0494
RRS Discovery	Western Core Box survey	WCB_02	1	-39.3028	-53.3197
RRS Discovery	Western Core Box survey	WCB_02	2	-39.0903	-54.0183
RRS Discovery	Western Core Box survey	WCB_03	1	-39.0377	-53.2892
RRS Discovery	Western Core Box survey	WCB_03	2	-38.8162	-53.9953
RRS Discovery	Western Core Box survey	WCB_04	1	-38.7506	-53.2539
RRS Discovery	Western Core Box survey	WCB_04	2	-38.5271	-53.9599
RRS Discovery	Western Core Box survey	WCB_05	1	-38.4486	-53.2194
RRS Discovery	Western Core Box survey	WCB_05	2	-38.2210	-53.9260
RRS Discovery	Western Core Box survey	WCB_06	1	-38.1403	-53.1844
RRS Discovery	Western Core Box survey	WCB_06	2	-37.9057	-53.8942
RRS Discovery	Western Core Box survey	WCB_07	1	-37.9670	-53.1552
RRS Discovery	Western Core Box survey	WCB_07	2	-37.7295	-53.8697
RRS Discovery	Western Core Box survey	WCB_08	1	-37.8312	-53.1487
RRS Discovery	Western Core Box survey	WCB_08	2	-37.5963	-53.8451