



CCAMLR

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**Multinational large-scale krill synoptic survey in CCAMLR Area 48 in 2019 – survey plan and protocol for consideration by SG-ASAM 2018**

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B.A. Krafft, O.A. Bergstad, T. Knutsen, G. Skaret, G. Macauley, et al.



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## 1 Abstract

2 The objective for the Multinational Large-Scale Krill Synoptic Survey in CCAMLR area 48  
3 in 2019 is to provide an updated estimate of the biomass of Antarctic krill (*Euphausia*  
4 *superba*) used in models to estimate sustainable yield. The planned survey follows, as close  
5 as possible, the design of the CCAMLR 2000 survey, that was undertaken in the year 2000.  
6 The basis for comparisons will depend on the degree of coverage and methodology and  
7 equipment available. The survey will involve the collaborative efforts of Norway,  
8 Association of Responsible Krill fishing companies (ARK: companies from Norway, Korea,  
9 China and Chile), United Kingdom, Ukraine, Korea and China, and hopefully also other  
10 nations that still needs to confirm their participation.

11 The current survey plan organization is presented for consideration by SG-ASAM. Norway  
12 has volunteered to co-ordinate the survey with other members dedicating personnel to  
13 specific tasks. It is requested that members who has already made commitments on ship time,  
14 also allocate contact personnel as proposed.

15 This paper has been developed after a wider consultation extending beyond the authors list. It  
16 discusses some specific organizational and technical challenges to be considered by SG-  
17 ASAM. We request advice from ASAM on “minimum requirements” regarding acoustic  
18 instrumentation and sampling gear to achieve approximate consistency with the CCAMLR  
19 B0 data collection protocol.  
20

## 21 Introduction and Background

22 During the 2017 session of the CCAMLR Scientific Committee (SC-CAMLR-XXXVI),  
23 Norway announced the intention to take the lead in organizing a full-scale survey (acoustics,  
24 biology, physics) of Area 48 based on the CCAMLR 2000 survey design, using both research  
25 vessels and commercial fishing vessels through an international cooperative effort. Central to  
26 this approach would be the first Southern Ocean expedition using Norway’s new polar  
27 research vessel RV *Kronprins Haakon* (KPH), in operation from mid-2018. The SC and  
28 several individual members welcomed this opportunity and responded positively to the  
29 initiative which was subsequently reported favorably to the Commission. At this time several  
30 nations and the krill industry have confirmed commitments to provide expertise and vessels  
31 to contribute to repeating the CCAMLR 2000 survey, and the commitments are sufficient to  
32 make a large-scale survey feasible.  
33

34 In a draft plan circulated to CCAMLR members in December 2017, the objectives and  
35 approach of the investigations were described. The investigations comprise two major  
36 elements; i.e. 1) the large-scale survey that provides updated estimates of the biomass of krill  
37 in Sub-Area 48 last conducted in 2000 (Hewitt et al. 2004; Watkins et al. 2004), and 2)  
38 localized land-based predator work combined with prey field observations in support of the  
39 further development of Feedback Management Approaches (FBM). (For details about the  
40 FBM related work, please see description submitted to the CCAMLR e-group (“Area 48 Krill  
41 Survey 2019”) in December 2017).

42 As it is considered imperative to discuss plans and protocols in SG-ASAM, this paper  
43 concerns the large-scale survey (Element 1) only. A revised survey plan will be presented to  
44 WG-EMM together with plans for work in support of the FBM approaches. The ultimate goal  
45 is to present a fully developed plan comprising all aspects to the Scientific Committee in  
46 October 2018.  
47

48 In this first presentation of the large-scale survey plan, specific challenges to be handled  
49 during the remaining planning period are highlighted. These concern ship-time commitments,  
50 technical aspects /acoustics, biological sampling), staffing of specialists and organization.  
51 Potential candidates for coordinating the work tasks described will be consulted during the  
52 ASAM meeting and a list of responsible persons will be developed after the meeting.

53

## 54 Ship-time and survey effort

55 Using the 2000 survey as a template, the nations and industry partners made commitments to  
56 survey specific sets of transects or subareas.

57 The survey will involve the collaborative efforts of Norway, Association of Responsible Krill  
58 fishing companies (ARK: companies from Norway, Korea, China and Chile), United  
59 Kingdom, Ukraine, Korea and China who has confirmed commitments (Table 1). With these  
60 commitments it is feasible to sample all transects operated during the 2000 survey.

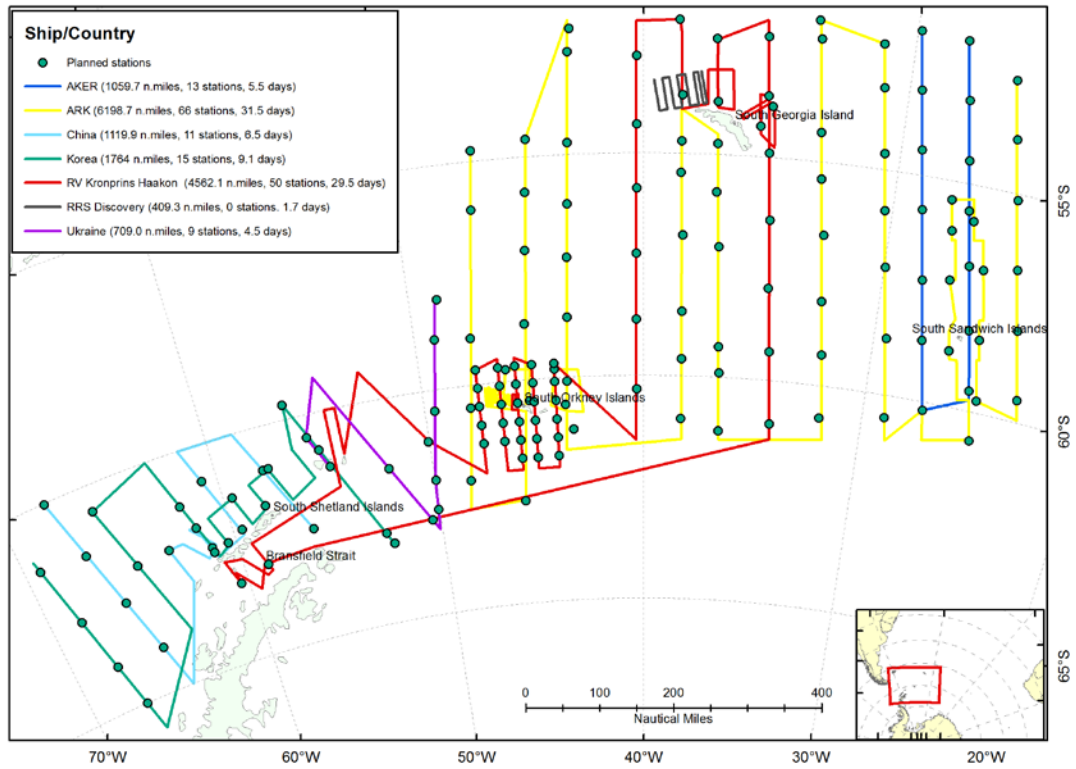
61 In addition, Peru and South Africa have expressed intentions to contribute, but has not yet  
62 made firm commitments (\* see Figure 1, Table 1).

63

64 The industry contribution comprises 35 survey days from ARK members and an additional 6  
65 days from AKER Biomarine. ARK dedicates FV *Cabo de Hornos* for the survey and the  
66 same vessel will most likely be used for the 6 additional Aker days. The industry has been  
67 attentive to the need for consistency and ease of operations and has thus committed a single  
68 rather than multiple vessels.

69

70 The RV *Kronprins Haakon* will be dedicated for the coverage by Norway for ca 29.5 days  
71 (the KPH will start the cruise in Punta Arenas (Chile) and end in Stanley (Falkland Islands)-  
72 in total 46 days is devoted for the large-scale coverage and the FBM related work with this  
73 vessel). Korea will contribute with their FV Kwangjaho for 10 days survey near the South  
74 Shetland Islands, United Kingdom will perform the Western Core Box transects north of  
75 South Georgia contributing 4 days with RRV *Discovery*, and Ukraine will contribute 5 days  
76 near South Sandwich Islands with their FV *More Sodruzhestva*, China will contribute for 7  
77 days on transects; their vessel, area coverage, acoustic equipment and trawl gear will be  
78 decided shortly.



80

81 Figure 1. Full coverage of the transect lines from the CCAMLR 2000 survey lines with  
82 confirmed participation. The coverage is based on 9 nm/hour cruising speed and an average  
83 station-time of 4 hours (vertical CTD casts, plankton nets and trawling). The ARK vessels  
84 coverage is based on 2 hours station time (pure trawl station with CTD (Seabird equipment)  
85 mounted to the trawl).

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97 Table 1. Nations confirmed with days dedicated for participating to the Large-Scale Survey  
 98 (LSS) and Feed Back Management (FBM) related work, and nations still not yet confirmed\*  
 99 (total days do not include transit time but actual days on transects, stations).  
 100

Nation	Type of research	
	platform	Total days
Norway	RV	20
ARK	FV	35
Aker	FV	7
Korea	FV	10
China	FV	7
Ukraine	FV	5
United Kingdom	RV	4
South Africa	RV	10*
Peru	RV	-*
Russia	Not participating	

101

102 **Challenge:**

103 To reduce uncertainty and facilitate good planning, it is requested that parties intending to  
 104 participate in the survey provide confirmations before or during the SG-ASAM.

105

106 **Acoustic survey strategy**

107 Design of tracks

108 Vessel impacts and design

109 Ground truthing

110 1. *Challenges: There has been several modifications to the B0-estimation protocol since the*  
 111 *2000 survey, and we ask SG-ASAM to revise whether the latest protocol is complete*  
 112 *and appropriate or if modifications are needed.*

113 2. *Include opportunities to do some inter-vessel calibration work, as part of the survey*  
 114 *design?*

115

116 **Acoustic instrumentation**

117 Acceptable combinations of frequencies

118 Within survey monitoring of performance (esp. noise) and acceptable remedies

119 Calibration

120 Settings & procedures

121

122 *Challenges: We ask SG-ASAM to consider exemplary acoustic data acquired from the vessels*  
 123 *(we have to request that these are provided, also from logging in passive mode) and*  
 124 *recommend if deviance from CCAMLR protocol settings should be considered (for instance*  
 125 *due to noise, low operational range at some frequencies etc.)*

126 *We ask SG-ASAM to evaluate whether/how uncertainty could be quantified when frequencies*  
 127 *are lacking compared to the B0-estimation protocol.*

128

129 Table 2. Confirmed vessels with frequencies used during the 2000 survey and potential  
130 additional acoustic equipment

Vessel	Frequency 38 KHz	120 kHz	200 kHz	Additional acoustic equipment
RV Kronprins Haakon (Norway)	EK80	EK80	EK80	EK80: 18, 70, 200, 333 kHz, Sonars: ME70, MS70, SU90, SH90
RRS Discovery (UK)	EK80	EK80	EK80	EK 80: 18, 70, 333 kHz
FV Cabo de Hornos (ARK)	EK80	ES70		Sonar: Furuno FSV30 21-27 kHz
FV Kwangjaho (Korea)	ES70	ES70		Other frequencies, sonars?
FV More Sodruzhestva (Ukraina)		ES70	ES70	Sonars: Furuno FSV-85 80 kHz, Wesmar HD-850, 110 kHz Echosounders: Kodon 28 kHz
China				Missing information

131

## 132 Acoustic data processing and storage

### 133 Procedures

134 *Challenges: We ask SG-ASAM to provide advice on a data processing workflow (which*  
135 *software/which output format, which templates, onboard processing or in workshops?)*

136

## 137 Strategies for biological sampling and processing

138 Length frequency distribution of krill is important for conversion of backscattering data to  
139 biomass via TS-estimation. The survey will also provide an opportunity to sample other  
140 biological characteristics of the krill stock across subareas 48.1 to 48.4.

141 The entire catch or a random subsample of minimum 100 individuals will be taken for length  
142 measurements; taken from the anterior margin of the eye to tip of telson excluding the setae  
143 ( $\pm 1$  mm), according to the “Discovery method” as outlined in Marr (1962).

144

145 During the CCAMLR 2000 survey, krill were sampled using a Rectangular Midwater Trawl  
146 with an 8 m<sup>2</sup> mouth opening (RMT-8; Baker et al., 1973) near local apparent noon and mid-  
147 night each day. The RMT-8 fished obliquely down to 200m and up to the surface. Standard  
148 lengths and maturity stages were determined for every krill if the catch was less than 100  
149 animals or a subsample of at least 100 animals if the catch was larger.

150

151 Also approved by CCAMLR as a collection tool for the implementation of the annual  
152 Norwegian krill survey in 48.2 (since 2011), a “Macroplankton trawl”, 45 m long, with a 36  
153 m<sup>2</sup> mouth-opening, constructed of 7 mm diamond shaped meshes (stretched), or a 3 mm light  
154 opening, from mouth opening to the cod-end is used. The trawl is towed using a 6-m wide  
155 steel beam, and 200 kg weights at each lower wing tip and 1000 kg attached to the beam to  
156 ensure fast deployment to depth and best possible geometric stability of the trawl during  
157 sampling. Signals from sensors attach to the trawl transfer data to the wheelhouse to monitor  
158 trawl operations and are stored for catch calculation. At each station the trawl is lowered  
159 vertically from surface to ~200 m depth (or ~20 m above bottom if the water is shallower  
160 than 200 m) and then hauled in at ~2.0 knots (including both vessel and wire speed).

161  
162 The Korean vessel will use a commercial krill trawl with a 15 mm meshed codend for  
163 direct sampling of krill.

164  
165  
166 Table 3. Nets and trawl gear employed by the vessels confirmed participation in the Large  
167 Scale survey

Vessel	Trawl/net gear
RV Kronprins Haakon (Norway)	Macroplankton trawl, 7 mm stretched mesh, 3 mm mesh light opening
RV Discovery (UK)	RMT8
FV Cabo de Hornos (ARK and Aker)	Macroplankton trawl, 7 mm stretched mesh, 3 mm mesh light opening
FV Kwangjaho (Korea)	Commercially used krill trawl with 15 mm codend
FV More Sodruzhestva (Ukraina)	Not determined
China	Missing information

168  
169 **Challenges:** The main challenge is ensuring comparability between the different nets  
170 available. We request advice from ASAM on resolving this issue and maintaining alignment  
171 with the gear used in the CCAMLR 2000 survey  
172 (<http://archive.ccamlr.org/pu/e/sc/ipy/RMT8protocol.pdf>)

### 173 174 Organization, communication and personnel

175 CCAMLR has an established krill fishery observer programme, which includes protocols for  
176 sampling and reporting the biological characteristics of krill.  
177 We note the data could also be submitted to KRILLBASE for inclusion in databases of  
178 postlarval density and biological characteristics, which are available to the wider scientific  
179 community. The former includes estimates of salp density.

180  
181 **Challenges:** The main challenge is to align the data collection and reporting with existing  
182 data reporting and management structures.

183 We request advice on the use of CCAMLR observer programme protocols (for length  
184 measurements, catch weighting, sexing and staging) and data reporting processes during the  
185 survey. Can the data be reported to and managed by the CCAMLR Secretariat using the  
186 observer programme system?

187  
188 We also request advice on submission of the data to KRILLBASE, and the feasibility of  
189 collecting additional salp data.

### 190 191 Data management, post-processing and reporting

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193 The biological data should be worked up into the inputs required for TS-estimation in good  
194 time to support the biomass estimation process. This might require analysis to identify the  
195 spatial structure of length-frequency distributions. There will be secondary products  
196 examining the biological structure of the stock. Two co-leaders will be appointed for this  
197 effort, who will also liaise with data managers and ensure that the full data set is available to  
198 all Members.

199

200 We request advice on the priority outputs required from the biological data, the appropriate  
201 spatial scales, and the timeline for delivery.

202

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