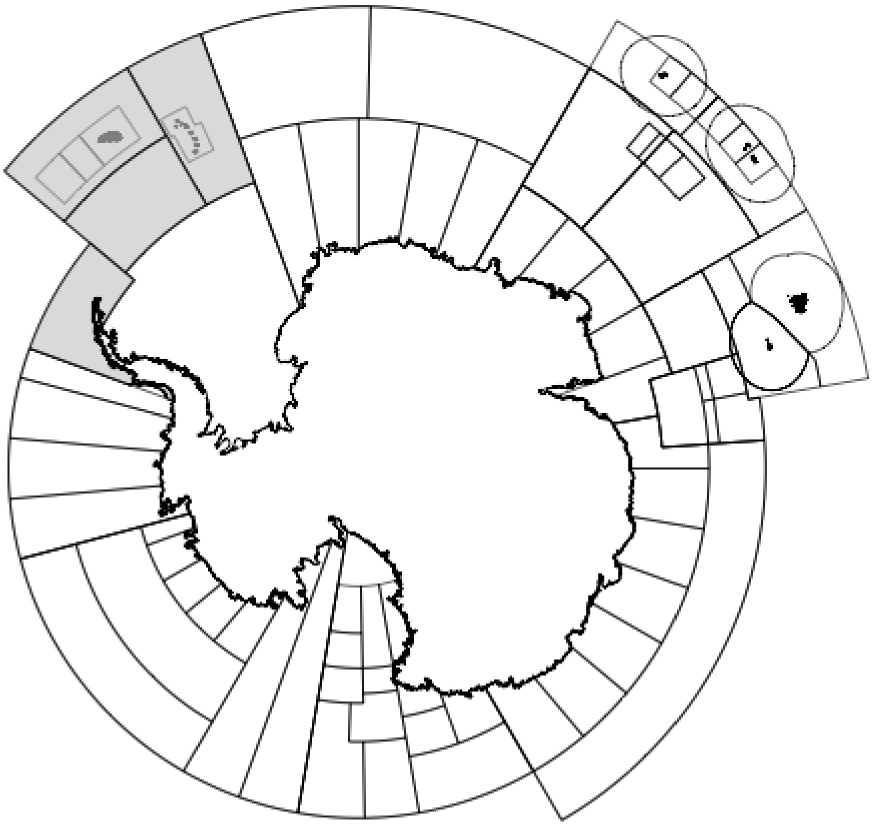
CCAMLR

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

Krill Fishery Report 2016

FISHERY REPORT



The map above shows the management areas within the CAMLR Convention Area, the specific region related to this report is shaded.

Throughout this report the CCAMLR fishing season is represented by the year in which that season ended, e.g. 2015 represents the 2014/15 CCAMLR fishing season (from 1 December 2014 to 30 November 2015).

Krill Fishery Report 2016

Introduction to the krill fishery

1. The commercial fishery for Antarctic krill (*Euphausia superba*) was initiated in 1961/62 when 47 tonnes were taken by two research vessels from the USSR. During the following decade, small catches of krill were reported by the USSR as part of the research phase of the fishery development. A multivessel multination fishery for krill was active by the early to mid-1970s (Figure 1).

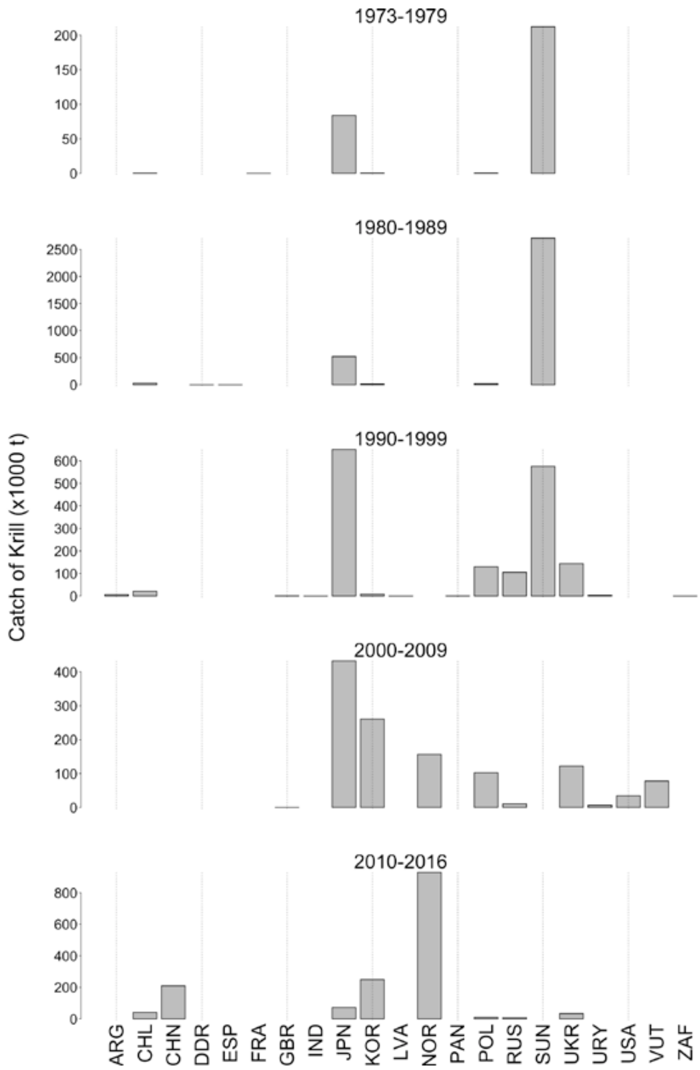


Figure 1: Catches of krill in the CAMLR Convention Area reported by Argentina (ARG), Chile (CHL), China (CHN), German Democratic Republic (DDR), Spain (ESP), United Kingdom (GBR), Japan (JPN), Republic of Korea (KOR), Latvia (LVA), Norway (NOR), Panama (PAN), Poland (POL), Russian Federation (RUS), USSR (SUN), Ukraine (UKR), Uruguay (URY), United States of America (USA), Vanuatu (VUT) and South Africa (ZAF). (Source: *Statistical Bulletin* – data filtered for krill as the target species.)

2. The history of catches in the krill fishery (Figure 2) indicates large changes around 1984 associated with technical difficulties in the fishery (Budzinski et al., 1985) and/or with an ecosystem anomaly that impacted the reproductive performance of krill predators at South Georgia that occurred in 1984 (Priddle et al., 1988). The large drop in catches from 1992 to 1993 reflects the redeployment of the eastern bloc far-seas fisheries fleet following the dissolution of the USSR. The focus of this report is on the most recent season (2015) for which data are complete as well as 2016, noting that not all data for this season are available at the time of publication. Earlier seasons are referred to where relevant.

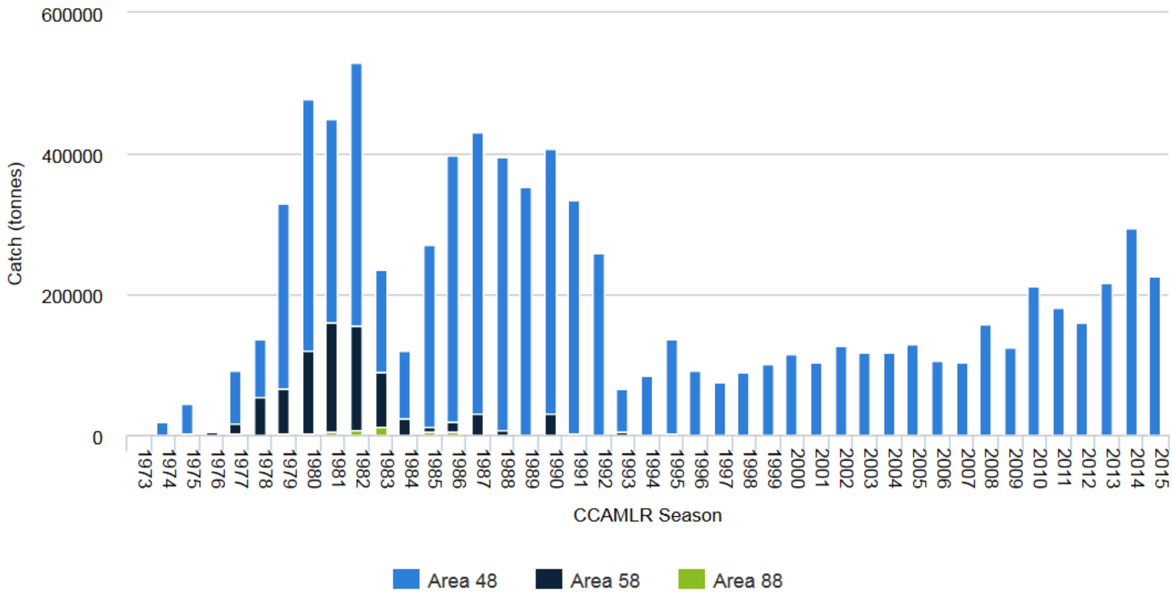


Figure 2: Total annual catches of krill (*Euphausia superba*) in the CAMLR Convention Area. (Source: www.ccamlr.org/node/74620.)

3. The CCAMLR database holds data on krill catches starting in 1973. Just over half of this catch was reported by the USSR (51%), with Japan (21%), Norway (9.5%), Republic of Korea (5.6%), Poland (3.4%) and Ukraine (3.4%) the other major fishing nations. The only CCAMLR Members that have fished for more than 10 years are Japan (40 years), Poland (33 years), Korea (27 years), USSR (18 years), Chile (18 years) and Ukraine (14 years). Catches of krill (where krill was the target species) have been reported by 19 nations, including catches reported by Latvia in 1993, Panama in 1995 and Vanuatu in 2004 and 2005 (Figure 1).

4. Within the past decade (including seasons 2005–2014), 41% of the total catch has been taken by Norway, 21% by Korea and 11% by Japan. The continuous fishing system (i.e. a system where the codend of the net is emptied via a pump connected to the vessel rather than being hauled aboard as in ‘traditional’ trawling) was first used in the krill fishery in 2004 by a Vanuatu-flagged vessel, this vessel also fished in 2005. It was replaced by a Norwegian-flagged vessel, also using the continuous fishing system, in 2006.

5. As the fishery has developed, the location of fishing has moved from the Indian Ocean to the Atlantic Ocean sector and has focussed almost entirely in the Atlantic sector since the early 1990s (Figure 3). In the past 10 years, the spatial distribution of the fishery has become focussed in the region of the Bransfield Strait off the Antarctic Peninsula (Subarea 48.1), to the northwest of Coronation Island (Subarea 48.2) and also to the north of South Georgia (Subarea 48.3).

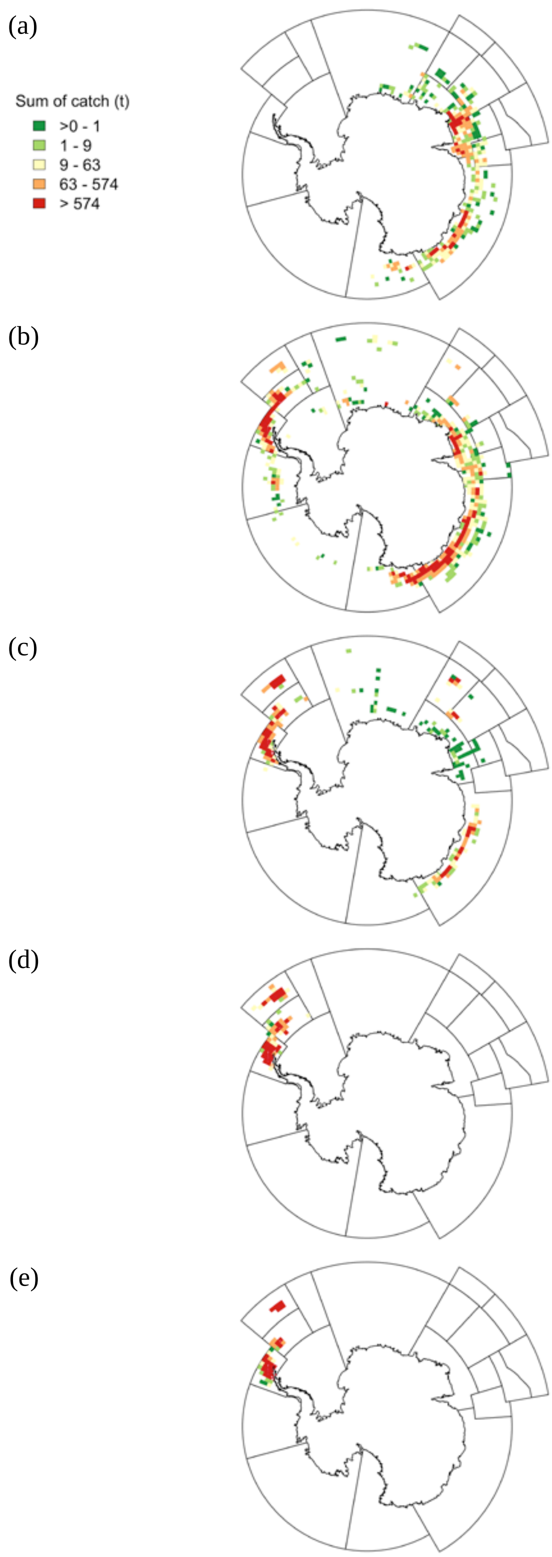


Figure 3: The spatial distribution of catches in the krill fishery reported to CCAMLR aggregated by 1° latitude by 2° longitude cells for (a) 1970 to 1979, (b) 1980 to 1989, (c) 1990 to 1999, (d) 2000 to 2009, and (e) 2010 to present.

6. The remainder of this report is focussed in the krill fishery in Area 48, noting that there are catch limits for krill in Divisions 58.4.1 and 58.4.2 (see Conservation Measures (CMs) 51-02 and 51-03) but there has been no commercial krill fishing in these two divisions in the past two decades.

Data reporting

Catch and effort reporting

7. Catch and effort reporting in the krill fishery is on a monthly basis (where reports of catch and effort in one month must be provided before the end of the following month) until the reported catch in a management area (i.e. an area with a spatially defined catch limit) reaches 80% of the catch limit. Where the reported catch exceeds 80%, then five-day catch and effort reporting is required (where catches and effort in a five-day period are reported within two working days of the end of that five-day period). For an area where the five-day reporting requirement has been triggered in a season, then in all subsequent seasons the change from monthly to five-day reporting occurs when the catch reaches 50% of the catch limit. The use of an adaptive reporting period approach was implemented in 2010 to help in the forward projection and closure forecasting in the krill fishery.

8. Haul-by-haul information from the krill fishery is provided on the C1 reporting forms (with data required to be submitted by the end of the month following data collection). In order to accommodate data from the continuous fishing system, in a format that is compatible with the reporting system for conventional trawling, catches are reported in 'haul intervals' of two hours in duration for all of the period that the net is in the water.

9. Monthly summaries of catch and effort in each management area that are provided at the end of each season by the Flag States, referred to as STATLANT data, are used in publicly available summaries of regional and global fishery statistics (e.g. *CCAMLR Statistical Bulletin*; *FAO Yearbook*).

Reported catch in 2015 and 2016

10. In 2015, 12 vessels fished in Subareas 48.1, 48.2 and 48.3 and the total catch of krill reported was 225 466 tonnes of which approximately 68% was taken from Subarea 48.1 (Table 1).

11. In 2016, 11 vessels fished in at least one of the three Subareas 48.1, 48.2 and 48.3; the total catch of krill reported in catch and effort reports was 260 174 tonnes (Table 2).

Table 1: Catch (tonnes) of krill reported from the fishery in Subareas 48.1, 48.2, 48.3 and 48.4 in 2015. Source: *CCAMLR Statistical Bulletin*, Vol. 28.

Month	Subarea				Total
	48.1	48.2	48.3	48.4	
December	1266				1266
January	13113	3358			16471
February	7147	13651			20798
March	46208				46208
April	45321	10			45331
May	41122	82	1		41205
June			16084		16084
July			15715		15715
August			14911		14911
September			7657		7657
Total	154177	17101	54368		225646

Table 2: Catch (tonnes) of krill reported from the fishery in Subareas 48.1, 48.2, 48.3 and 48.4 in 2016. (Source: catch and effort reports.)

Month	Subarea				Total
	48.1	48.2	48.3	48.4	
December	11452				11452
January	4762	21303			26065
February	12367	12811			25178
March	37546				37546
April	35189	188			35377
May	53147				53147
June			15716		15716
July			24155		24155
August			25747		25747
September			5791		5791
Total	154463	34302	71409		260174

12. In both 2015 and 2016, fishing occurred in Subarea 48.1 in December and January, particularly in the southern part of Bransfield Strait (Gerlache Strait) (see Appendix 2). The pattern for February and March was similar with a focus towards Bransfield Strait in April and into May prior to the closure of Subarea 48.1 (closure of Subarea 48.1 occurred on 28 May in both 2015 and 2016). In 2015 and 2016, fishing in Subarea 48.2 was most intensive in January and February with relatively small catches at other times (Tables 1 and 2). As in previous years, fishing in Subarea 48.3 occurred during the period from June to September.

Scientific observer data reporting

13. The implementation of the CCAMLR Scheme of International Scientific Observation (SISO) in the krill fishery has been the subject of extensive discussion in the Scientific Committee and Commission meetings (see WG-EMM-14/58, Annex 1). The development of a program for systematic observer coverage in the krill fishery was first implemented in 2010

(CM 51-06). In 2016, the Commission agreed to revise CM 51-06 to introduce a phased increase in the required observer coverage in the krill fishery to achieve a target coverage rate of no less than 50% of vessels during the 2016/17 and 2017/18 fishing seasons; no less than 75% of vessels during the 2018/19 and 2019/20 fishing seasons; and 100% coverage in subsequent fishing seasons.

14. Observer coverage in the krill fishery, defined as the number of days when an observer was on a krill fishing vessel as a percentage of the days fished, for the period 2010–2015 showed that 90% of fishing days had been observed and 92% of vessels had achieved 100% observer coverage (Table 3). The nature of the operation of the krill fishery means that, for an individual subarea in a season, most vessels have either 100% or 0% coverage with a relatively small number having intermediate values.

15. The increase in scientific observer data available from the krill fishery has provided a basis for greater specification of sampling requirements, including those on the length, sex and maturity stage of krill, fish by-catch and the collection of acoustic data on krill. The length-frequency distributions of krill reported by observers in Subareas 48.1, 48.2 and 48.3 for each fishing season since 2011 show interannual variability among all seasons and strong cohort progression from 2008 to 2010 (Figure 4).

16. Analyses of the factors influencing variability in the length-frequency distributions of krill collected by observers identified the greatest source of variability to be the timing and location of sampling (rather than a gear or vessel effect). Based on these analyses, the Working Group on Ecosystem Monitoring and Management (WG-EMM) recommended in 2015 that the observer data length-frequency distributions could be aggregated by subarea and month, with the additional recommendation that, in the case of Subarea 48.1, the length-frequency distributions were further aggregated for areas to the north and south of the South Shetland Islands (Figure 5).

17. The length-frequency distributions by month and subarea for the most recent complete season, 2015, are shown in Figure 6 and for the current (incomplete) season, 2016, are shown in Figure 7. The month by subarea length-frequency distribution plots for all fishing seasons from 2001 to 2014 are provided in Appendix 1.

Table 3: Observer coverage, the number of days when an observer was on board a krill fishing vessel as a percentage of the days fished, in Subareas 48.1, 48.2 and 48.3 from 2006 to 2016. Note that the data for 2016 are incomplete and reflect observer data received at 31 December 2016.

Subarea	Season										
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	*2016*
48.1	23	17	50	17	75	80	77	88	92	92	*64*
48.2	0	20	40	48	89	82	76	88	93	83	*67*
48.3	53	31	43	100	100	96	100	77	100	100	*26*

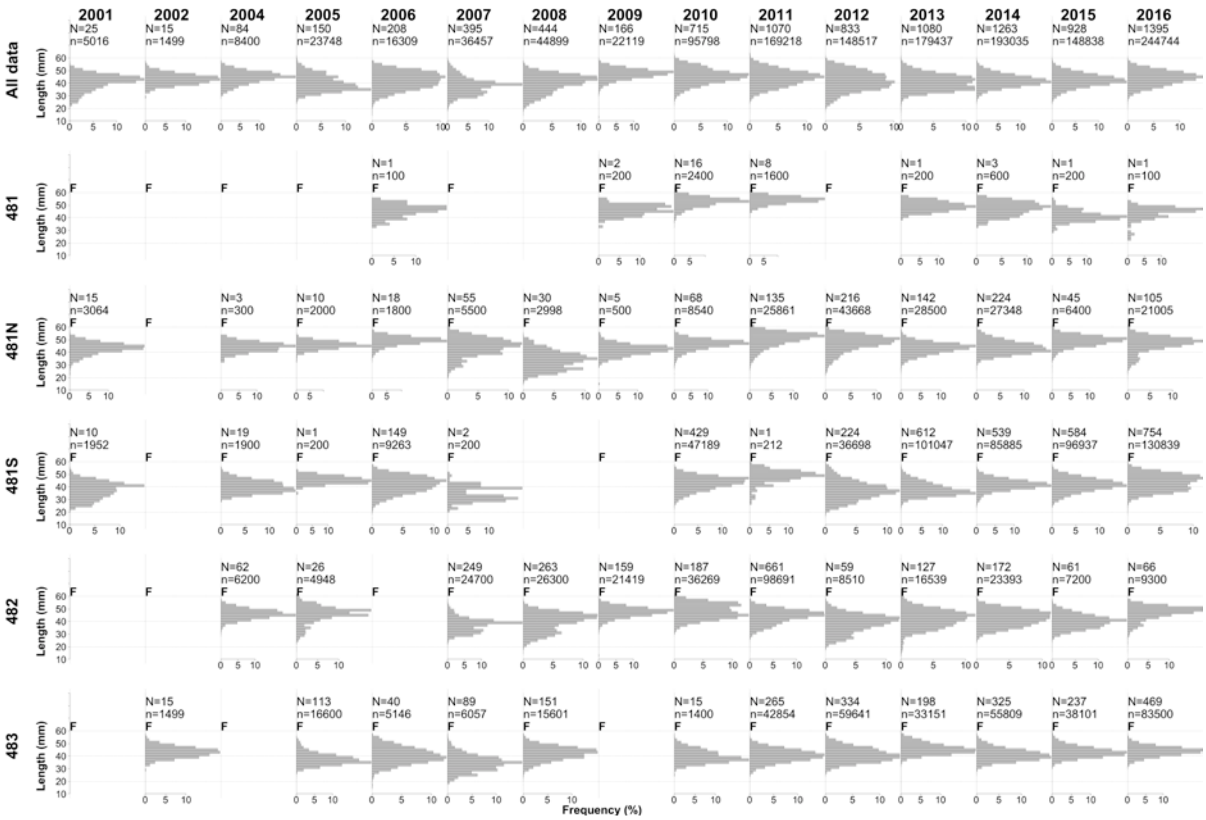


Figure 4: Annual length-frequency distributions for krill, presented by fishing season from 2001 to the present season, in Area 48 (top panel) and in Subareas 48.1 (N and S see Figure 5), 48.2 and 48.3 (lower panels). The number of hauls from which krill were measured (N) and the number of fish measured (n) in each year are provided; the months in which fishing occurred in a subarea are indicated by the letter F. Note: No length data was recorded in 2003.

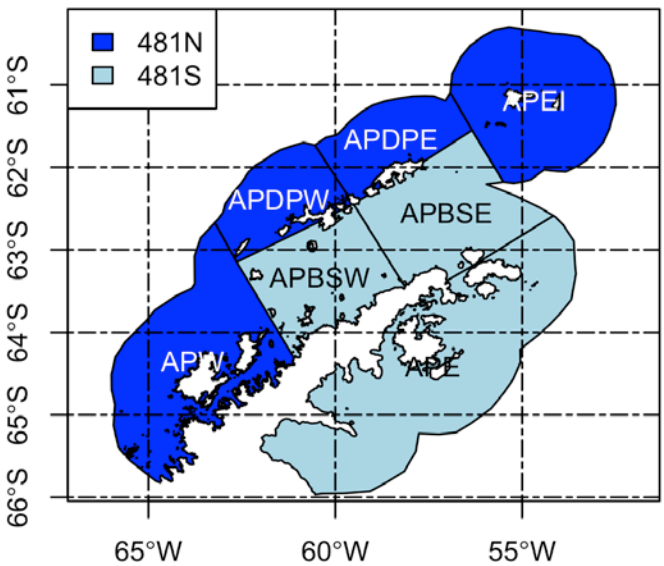


Figure 5: Small-scale management units (SSMUs) in the areas to the north and south of the South Shetland Islands in Subarea 48.1 used for the aggregation of length-frequency distributions of krill (following the recommendation of WG-EMM-15 – SC-CAMLR-XXXIV, Annex 6, paragraph 2.10). Details of the labels for each SSMU are given in Table A2.1.

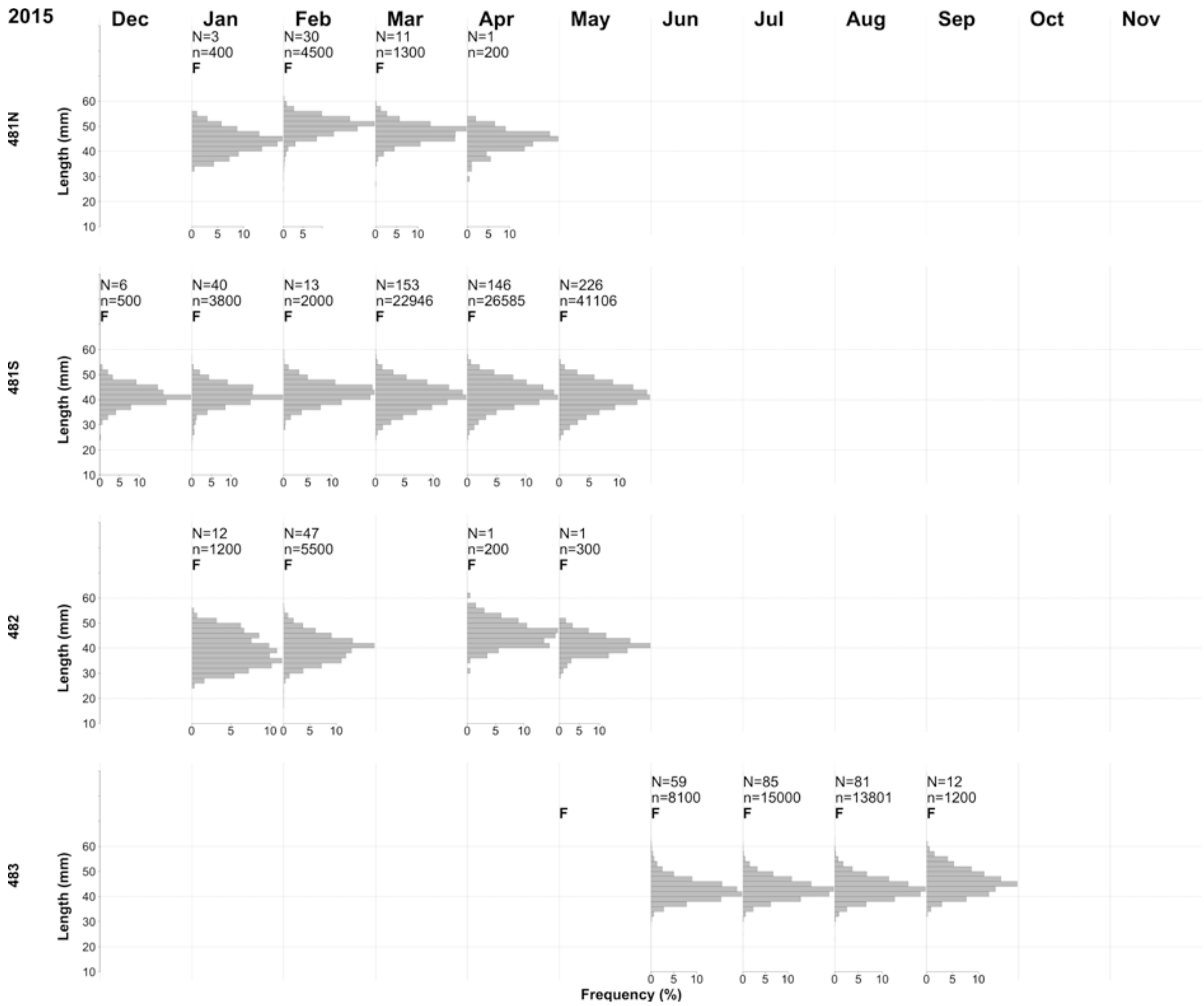


Figure 6: Monthly length-frequency distributions for krill in Subareas 48.1 (N and S), 48.2 and 48.3 in 2015. The number of hauls from which krill were measured (N) and the number of fish measured (n) in each month are provided; the months in which fishing occurred in a subarea are indicated by the letter F.

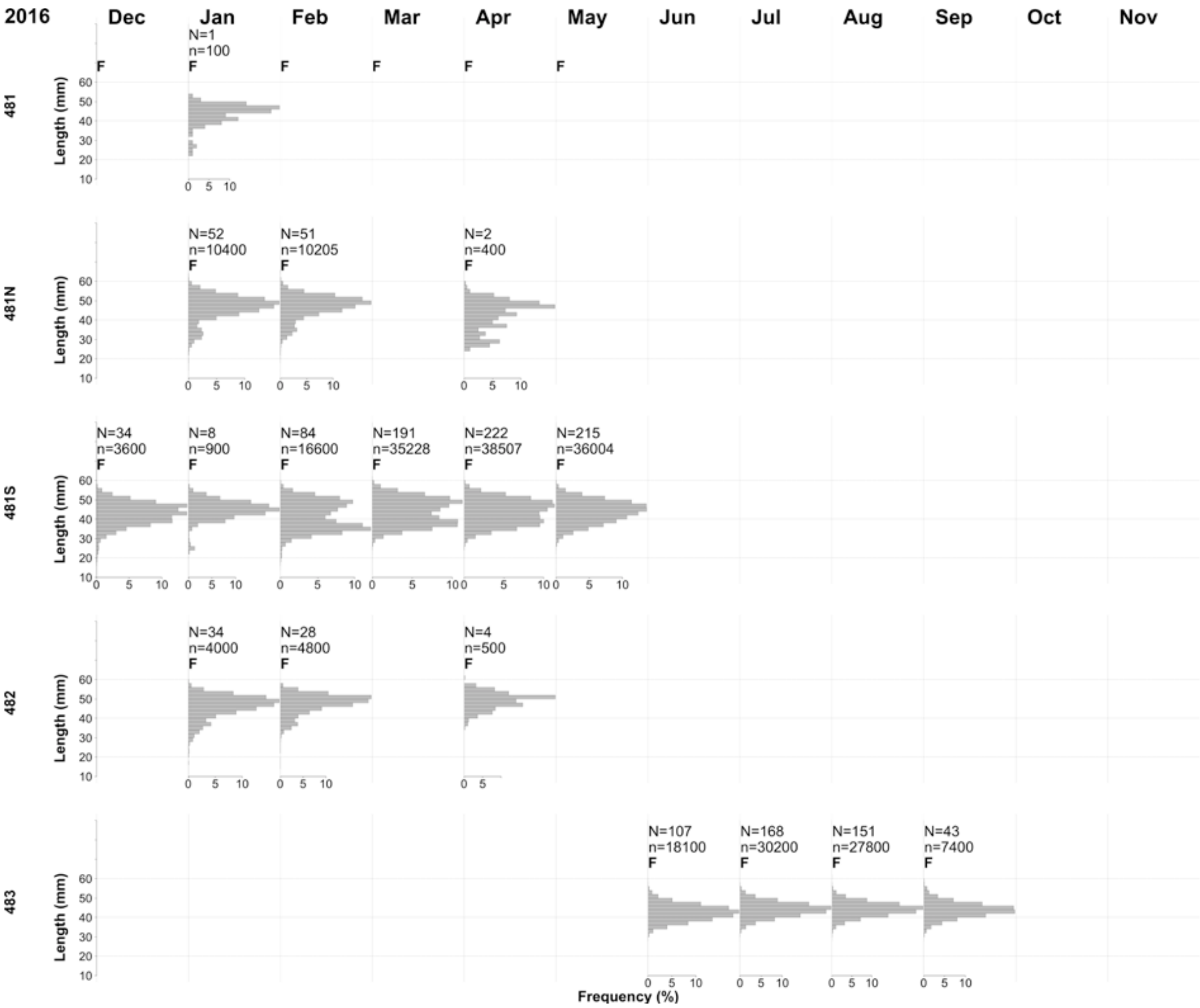


Figure 7: Monthly length-frequency distributions for krill in Subareas 48.1 (including N and S), 48.2 and 48.3 in 2016. The number of hauls from which krill were measured (N) and the number of fish measured (n) in each month are provided; the months in which fishing occurred in a subarea are indicated by the letter F.

Non-target catch

Fish by-catch

18. Detailed information on the fish by-catch reported from the krill fishery was provided in WG-FSA-16/04 using data on fish by-catch in the krill fishery from commercial catch (C1) data (95 513 hauls) and SISO data (11 875 hauls). The analysis, based on the frequency of occurrence, proportion by mass, length-frequency distribution and geographic provenance of the key fish taxa reported, indicated a high degree of overlap in the most frequently reported taxa in the C1 data and SISO data, with painted rockcod (*Lepidonotothen larseni*) and spiny icefish (*Chaenodraco wilsoni*) the most frequently reported in both datasets. The estimated total annual mass of fish by-catch in a 300 000 tonnes krill fishery would be 370 tonnes, comprising 40% mackerel icefish (*Champsocephalus gunnari*) and 30% *L. larseni*.

19. The length-frequency distribution of all taxa for which >100 fish were measured had a modal size class of <10 cm. The fish species taken as by-catch in the krill fishery are the same

species (and size classes) as those reported in the diet of 'krill-dependent' predators. There is evidence of both an increase in the data quality from the observer scheme, as reflected in the reduced confidence intervals around the frequency of occurrence data, as well as an increase in the fish by-catch reported in the commercial krill catch data.

Incidental mortality of seabirds and marine mammals

20. No incidental mortalities were observed in 2015. In 2016, a total of nine seabird mortalities were reported from the krill fishery, one in Subarea 48.1 and eight in Subarea 48.1.

Incidental mortality of fur seals in the krill fishery

21. Prior to 2003, no incidental fur seal catches had been reported from the krill fishery. In 2003, discussions on the level of Antarctic fur seal (*Arctocephalus gazella*) mortality associated with the krill trawl fishery first took place in the Working Group on Incidental Mortality Associated with Fishing (WG-IMAF). This was prompted by information included in the Report of Members' Activities that in the krill fishery in Area 48, between 13 March and 26 August 2003, 73 Antarctic fur seals had been caught by one vessel in the krill fishery (of which 26 were killed and 47 were released alive). WG-IMAF recommended that vessel operators and researchers collaborate to develop and implement mitigation methods and requested that the Scientific Committee address how best to arrange appropriate reporting from the krill fishery (SC-CAMLR-XXII, Annex 5, paragraph 6.231).

22. In 2004, data collected as part of SISO indicated that 292 fur seals were caught in Subarea 48.3. Some Members investigated and documented the use of mitigation devices to reduce seal entrapment in krill trawl nets and reported on the efficacy of seal-exclusion devices (SEDs). The Commission endorsed a recommendation by the Scientific Committee that a description of all methods be compiled into one document and distributed amongst CCAMLR Members (CCAMLR-XXIII, paragraph 5.20). WG-IMAF also discussed the apparent inconsistencies and inadequacies of observer data on incidental mortality of fur seals and recommended the Commission require all krill trawl vessels to carry an observer to improve by-catch mitigation management efforts (SC-CAMLR-XXIII, Annex 5, paragraph 7.236).

23. In 2005, the number of seals observed captured in Area 48 was reduced to 97, however, the Scientific Committee reiterated its recommendations that every krill fishing vessel should employ a SED and that observers should be required on krill trawls to collect reliable data on mortalities and efficacy of mitigation devices (SC-CAMLR-XXIV, paragraphs 5.41i and ii). Observer reports were only received from four of nine trawl vessels in Area 48 in 2005 and this level of observer coverage was considered insufficient to estimate the total seal mortality in the fishery. WG-IMAF again recommended 100% coverage on all krill trawl vessels. One fur seal was captured in each of 2006 and 2007, although the level of observer coverage remained less than 100%. The Scientific Committee stressed the continued need for monitoring of incidental mortalities and for an improved reporting process on the use of mitigation devices within the trawl fishery in order to document which measures were successful (SC-CAMLR-XXVI, paragraph 5.13).

24. In 2008, six seal mortalities were observed in Subarea 48.3 and the Scientific Committee suggested the krill fishery notification pro forma should be amended to include specific information on gear configurations such as mesh size, net opening, presence and design of SEDs (SC-CAMLR-XXVII, paragraph 4.11). The Commission agreed to amend the general mitigation provisions in CM 25-03 to introduce the mandatory use of mammal exclusion devices on trawls in the krill fisheries in Area 48 (CM 51-01) and Divisions 58.4.1 (CM 51-02) and 58.4.2 (CM 51-03). The conservation measures were adopted by the Commission and are still in force.

25. There were no seal mortalities reported between 2008 and 2014, however, there were three mortalities of Antarctic fur seals in both 2015 and 2016.

Estimation of krill green weight

26. At its meeting in 2008, WG-EMM considered how the actual catches of krill are reported as the mass of product multiplied by a conversion factor to estimate the 'green weight' and expressed its concern over the inconsistency in the way the amount of krill removed from the ecosystem may be recorded. Given the different on-board processing methods used by vessels, and the resulting range of conversion factors used in the krill fishery, the need to have clarity on how the estimates of green weight are derived is important in accurately determining the true 'green weight' of krill removed from the ecosystem. Conversion factors were reported from some vessels, either as pre-determined product-specific values or varying according to ongoing evaluation on the vessel.

27. In 2011, the Scientific Committee noted there were several sources of uncertainty in estimating the green weight of krill that required further investigation (SC-CAMLR-XXX, paragraph 3.15). In order to progress analyses of uncertainty in green weight, the specific details of the method used for estimating catch on all krill vessels was included in the notification process. This issue remains an important consideration in WG-EMM.

CCAMLR's approach to managing the krill fishery

28. The estimate of the standing stock of krill in Area 48 is based on the CCAMLR 2000 Krill Synoptic Survey of Area 48 (CCAMLR-2000 Survey) (Trathan et al., 2001). This estimate has been revised on the basis of methodological improvements in the processing and analysis of acoustic data (SC-CAMLR-XXIX, Annex 5, paragraphs 2.40 to 2.44).

29. In 2010, the Scientific Committee agreed that the best estimate of krill biomass during the CCAMLR-2000 Survey was 60.3 million tonnes. Based on the krill stock assessment model, CCAMLR agreed to the current precautionary catch limit for krill of 5.61 million tonnes per season (1 December to 30 November of the following year) in Subareas 48.1, 48.2, 48.3 and 48.4 combined. This catch limit was based on a B_0 estimate of 60.3 million tonnes with a survey CV of 12.8% and a fraction of the population referred to as γ (gamma) estimated using the generalised yield model (GYM) of 0.093.

30. CCAMLR sets precautionary catch limits for krill using a set of decision rules to determine what proportion of the stock can be fished while still achieving the objective of the

Convention. To do this, the population of krill is projected forward in time using a population model to allow the effects of different catch levels to be simulated (Figure 8). The distribution in blue shows the range of potential starting points for the simulations. For each projection a starting point is chosen at random and the population is projected forward with the key parameters (such as recruitment, growth and mortality) drawn at random from plausible ranges to account for natural variability (and uncertainty in these parameters).

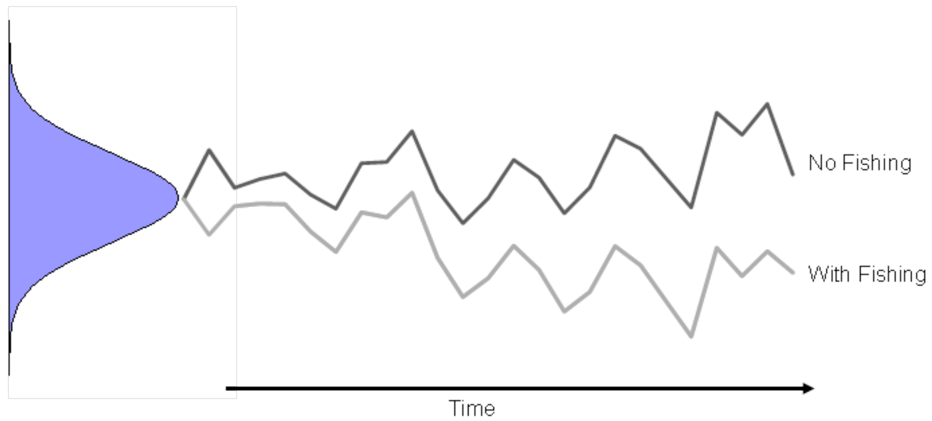


Figure 8: Schematic of krill population projection.

31. The actual catch limit for krill is set on the basis of a sustainable yield (γ) that can be taken as a constant catch. This is estimated using the GYM. After repeatedly projecting the pre-exploitation population forward with different yield levels (i.e. a different fraction of the starting population taken as a constant catch in each year of the projection) the following rules are used to determine the final estimate of yield:

1. Choose a yield, γ_1, so that the probability of the spawning biomass dropping below 20% of its median pre-exploitation level over a 20-year harvesting period is 10%.

2. Choose a yield, γ_2, so that the median escapement at the end of a 20-year period is 75% of the median pre-exploitation level.

3. Select the lower of γ_1 and γ_2 as the yield.

The actual catch limit is the level of yield selected in step 3, as that is a value of gamma that is consistent with both of the objectives, multiplied by the estimate of the stock size from a survey of that stock (see also Figure 9).

32. In setting the 5.61 million tonne catch limit over such a large area, CCAMLR recognises that the fishery has the potential to be spatially restricted and has the potential for localised, potentially negative, ecosystem impacts. In recognition of this risk, CCAMLR introduced a trigger level of 620 000 tonnes above which the fishery cannot proceed until there is an agreed mechanism to distribute catches in a manner designed to avoid localised impacts. The trigger level was selected as it represented the combined maximum historic catches reported from each subarea (although at no point in the history of the krill fishery has a catch as high as 620 000 tonnes been taken in one year). The trigger level has been subdivided such that catches in any one season may not exceed 25% of the trigger level

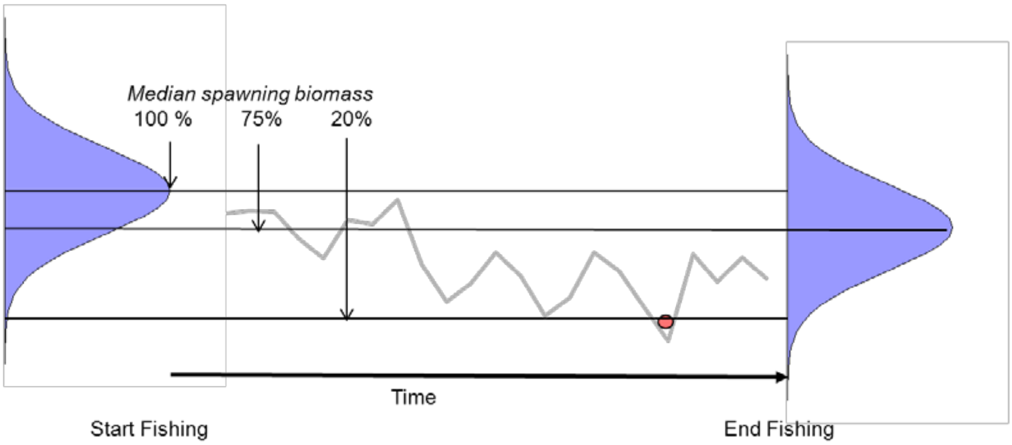


Figure 9: Schematic of krill population projection showing the decision rule information.

(155 000 tonnes) in Subarea 48.1 and 45% (279 000 tonnes) in Subareas 48.2 and 48.3 (CM 51-07) (for schematic, see Figure 10). In 2003, CCAMLR agreed to the definition of a suite of small-scale management units (SSMUs) in Area 48 that are based on the distribution of krill, krill-predators and the fishery, however, there has been no agreement on the allocation of catches at this scale (a map of SSRUs and catches of krill in those SSMUs is provided in Appendix 2).

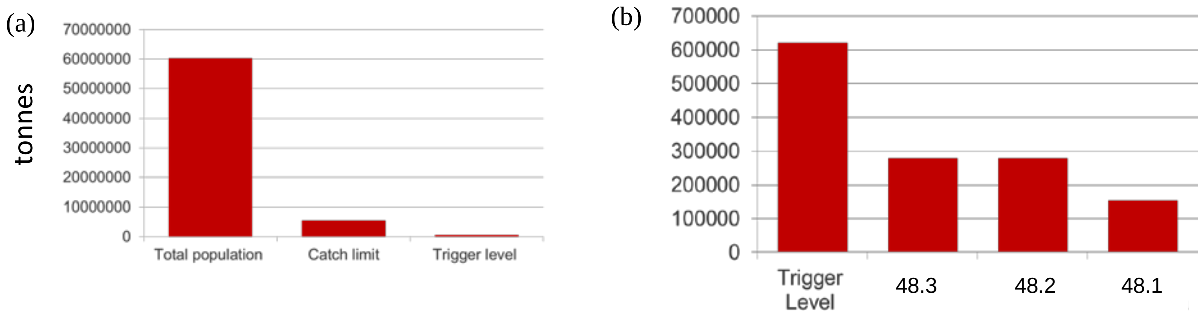


Figure 10: Schematic of (a) the total population size of krill and associated catch limit and trigger level in Area 48, and (b) and the trigger levels in Subareas 48.1, 48.2 and 48.3.

33. The current trigger level is not linked to the assessment of krill biomass and so in 2010, although the precautionary catch limit was amended, the trigger level was not changed at that time. Additionally, in discussions related to the use of the GYM, WG-EMM considered in 2008 the application of the current three-stage decision rule used by CCAMLR to determine the precautionary catch limit for krill and noted that for stocks such as krill that experience high interannual variability in abundance, the probability with which the biomass may fall below 20% of the initial biomass may be greater than 0.1 even in the absence of fishing (SC-CAMLR-XXVII, Annex 4, paragraph 2.62). This would result in sustainable yield (γ_1) being equal to 0 and hence a modification of this part of the decision rule may be required to ensure that the objectives in Article II of the CAMLR Convention can still be met. Given also the potential impact of climate change on recruitment variability, the Working Group agreed that both the recruitment variability and the specification of the current decision rule relating to the maintenance of stable recruitment should be further investigated (SC-CAMLR-XXIX, Annex 6, paragraph 2.78).

Current management advice and related conservation measures relating to the krill fishery

34. The limits on the fishery for krill in Area 48 are summarised in Table 4.

Table 4: A summary of CCAMLR limits in force and related conservation measures for the krill fishery in Subareas 48.1, 48.2, 48.3 and 48.4 in 2016.

Element	Limits in force
Target species	The target species is *Euphausia superba* and any species other than *Euphausia superba* is by-catch
Access (gear)	Trawling only
Notification	All Members intending to fish for krill must notify the Commission in accordance with CM 21-03
Catch limit	155 000 tonnes in Subarea 48.1, 279 000 tonnes in each of Subareas 48.2 and 48.3, and 93 000 tonnes in Subarea 48.4 (CM 51-07)
Move-on rule	No move-on rules apply.
Season	1 December to 30 November of the following year
By-catch	By-catch rates as in CM 33-01 apply in Subarea 48.3
Bird and mammal mitigation	Specific advice/requirements in accordance with CM 25-03 and CM 51-01
Observers	Scientific observers should be deployed on vessels in accordance with CM 51-06
Data	Monthly and/or five-day catch and effort reporting Haul-by-haul catch and effort data Data reported by the CCAMLR scientific observer
Research	No specific requirement
Environmental protection	Regulated by CM 26-01 during fishing operations

Ecosystem implications and effects

35. Recognition of the central role of krill in the ecosystem is at the core of the approach taken by CCAMLR in the management of the krill fishery. One element of this is, the CCAMLR Ecosystem Monitoring Program (CEMP), was established in 1985 to detect changes in the krill-based ecosystem to provide a basis for regulating harvesting of Antarctic living marine resources in accordance with the ‘ecosystem approach’. The program aims to:

- detect and record significant changes in critical components of the ecosystem, to serve as a basis for the conservation of Antarctic marine living resources
- distinguish between changes due to the harvesting of commercial species and changes due to environmental variability, both physical and biological.

Further information and analysis on CEMP can be found in WG-EMM-16/08, 16/09 and 16/10.

Fishing notifications for 2017

36. Members intending to participate in established fisheries for krill in 2017 (in Subareas 48.1, 48.2, 48.3 and 48.4 and Divisions 58.4.1 and 58.4.2) had to notify the Commission no later than 1 June 2016. The procedures for krill fishery notification submissions are described in CM 21-03. For 2017, seven Members notified their intention to fish for krill with a total of 18 vessels (Table 5); these notifications are often subject to revisions/withdrawals of vessels and the most up-to-date information can be found at www.ccamlr.org/en/fishery-notifications/notified/krill.

Table 5: Notifications (N) of intention to fish for krill in 2017 by subarea/division.

Vessel name	Member	Subarea/division					
		48.1	48.2	48.3	48.4	58.4.1	58.4.2
Saint Pierre	Chile	N	N	N			
Betanzos	Chile	N	N	N			
Fu Rong Hai	China	N	N	N	N		
Ming Kai	China	N	N	N	N	N	N
Long Fa	China	N	N	N	N		
Long Teng	China	N	N	N	N	N	N
Long Da	China	N	N	N	N		
Ming Xing	China	N	N	N	N		
Kai Fu Hao	China					N	N
Sejong	Korea, Republic of	N	N	N			
Kwang Ja Ho	Korea, Republic of	N					
Insung Ho	Korea, Republic of	N	N				
Saga Sea	Norway	N	N	N	N		
Antarctic Sea	Norway	N	N	N	N		
Juvel	Norway	N	N	N			
Alina	Poland	N	N	N	N		
Saga	Poland	N	N	N	N		
More Sodruzhestva	Ukraine	N	N	N			
Total Members		6	6	6	3	1	1
Total vessels		17	16	15	10	3	3

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Budzinski, E., P. Bykowski and D. Dutkiewicz. 1985. Possibilities of processing and marketing of products made from Antarctic krill. *FAO Fish. Tech. Pap.*, 268. FAO, Rome: 46 pp.

Priddle, J., J.P. Croxall, I. Everson, R.B. Heywood, E.J. Murphy, P.A. Prince and C.B. Sear. 1988. Large-scale fluctuations in distribution and abundance of krill – a discussion of possible causes. In: Sahrhage, D. (Ed.). *Antarctic Ocean and Resources Variability*. Springer-Verlag, Berlin Heidelberg: 169–182.

Trathan, P.N., J.L. Watkins, A.W.A. Murray, A.S. Brierley, I. Everson, C. Goss, J. Priddle, K. Reid, P. Ward, R. Hewitt, D. Demer, M. Naganobu, S. Kawaguchi, V. Sushin, S.M. Kasatkina, S. Hedley, S. Kim and T. Pauly. 2001. The CCAMLR-2000 Krill Synoptic Survey: a description of the rationale and design. *CCAMLR Science*, 8: 1–24.

Monthly length-frequency distributions for krill

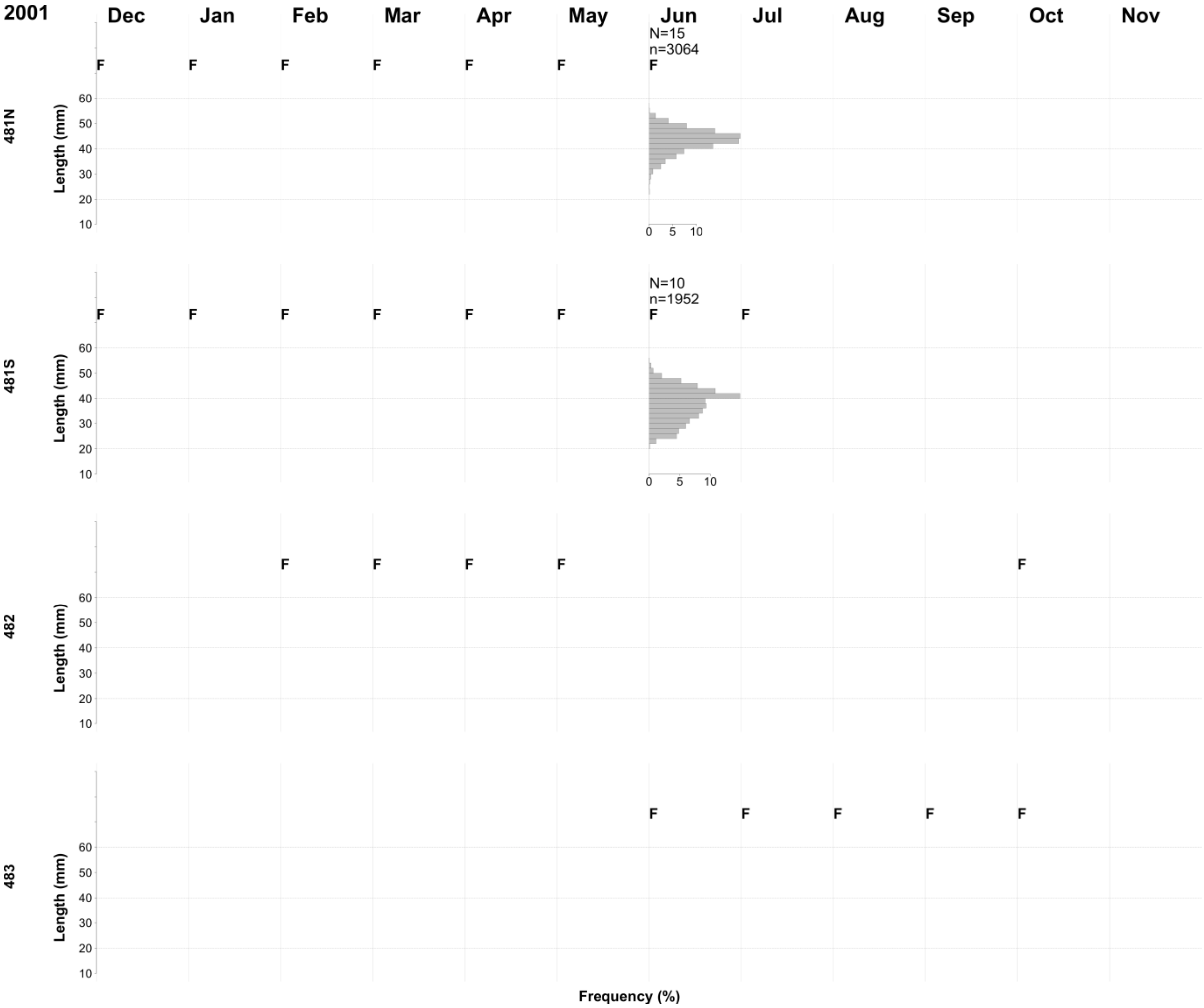

Figure A1.1: Monthly length-frequency distributions for krill in in Subareas 48.1 (N and S), 48.2 and 48.3 in 2001. The number of hauls from which krill were measured (N) and the number of fish measured (n) in each month are provided; the months in which fishing occurred in a subarea are indicated by the letter F.

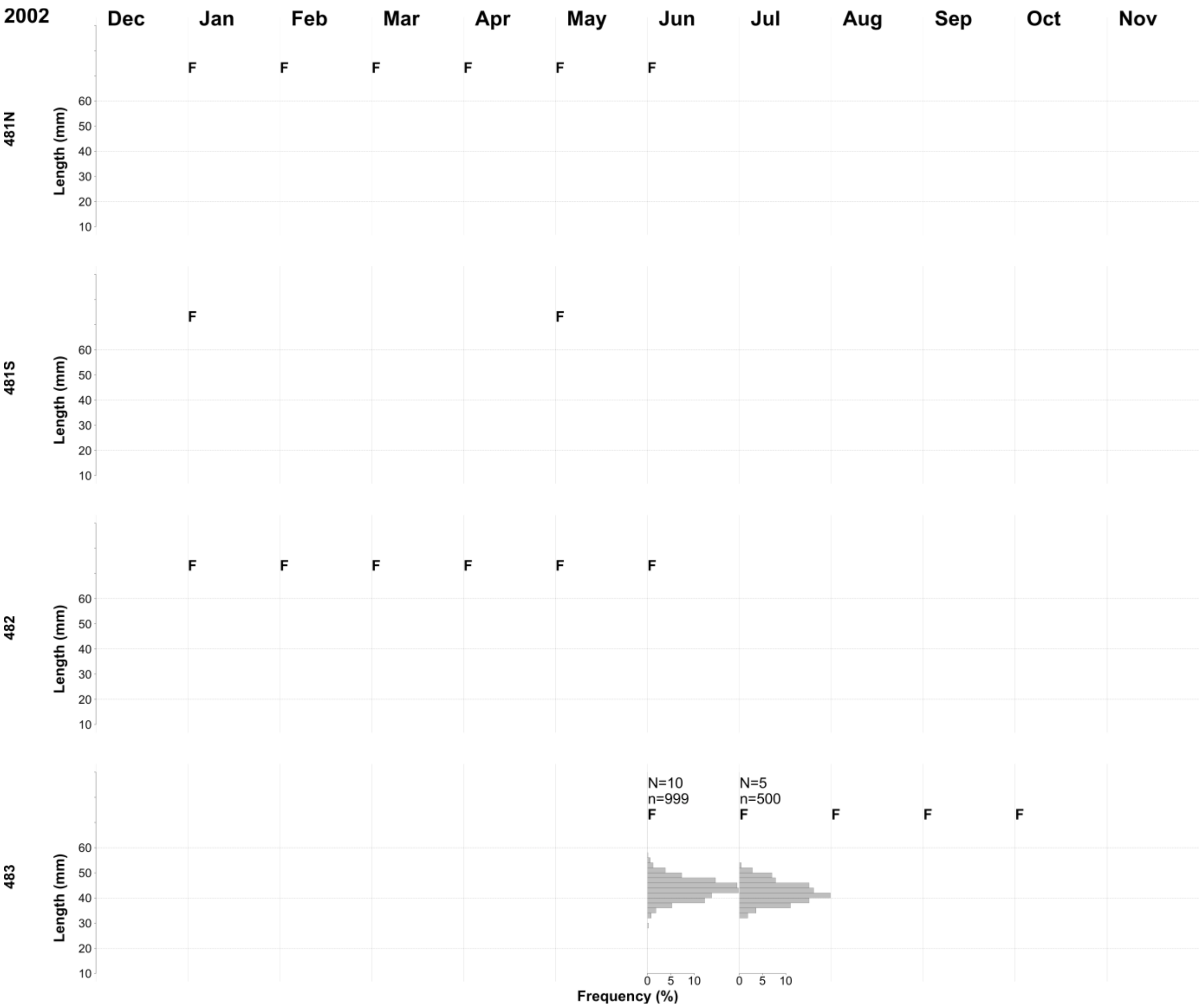

Figure A1.2: Monthly length-frequencies for krill in Subareas 48.1 (N and S), 48.2 and 48.3 in 2002. The number of hauls from which krill were measured (N) and the number of fish measured (n) in each month are provided; the months in which fishing occurred in a subarea are indicated by the letter F.

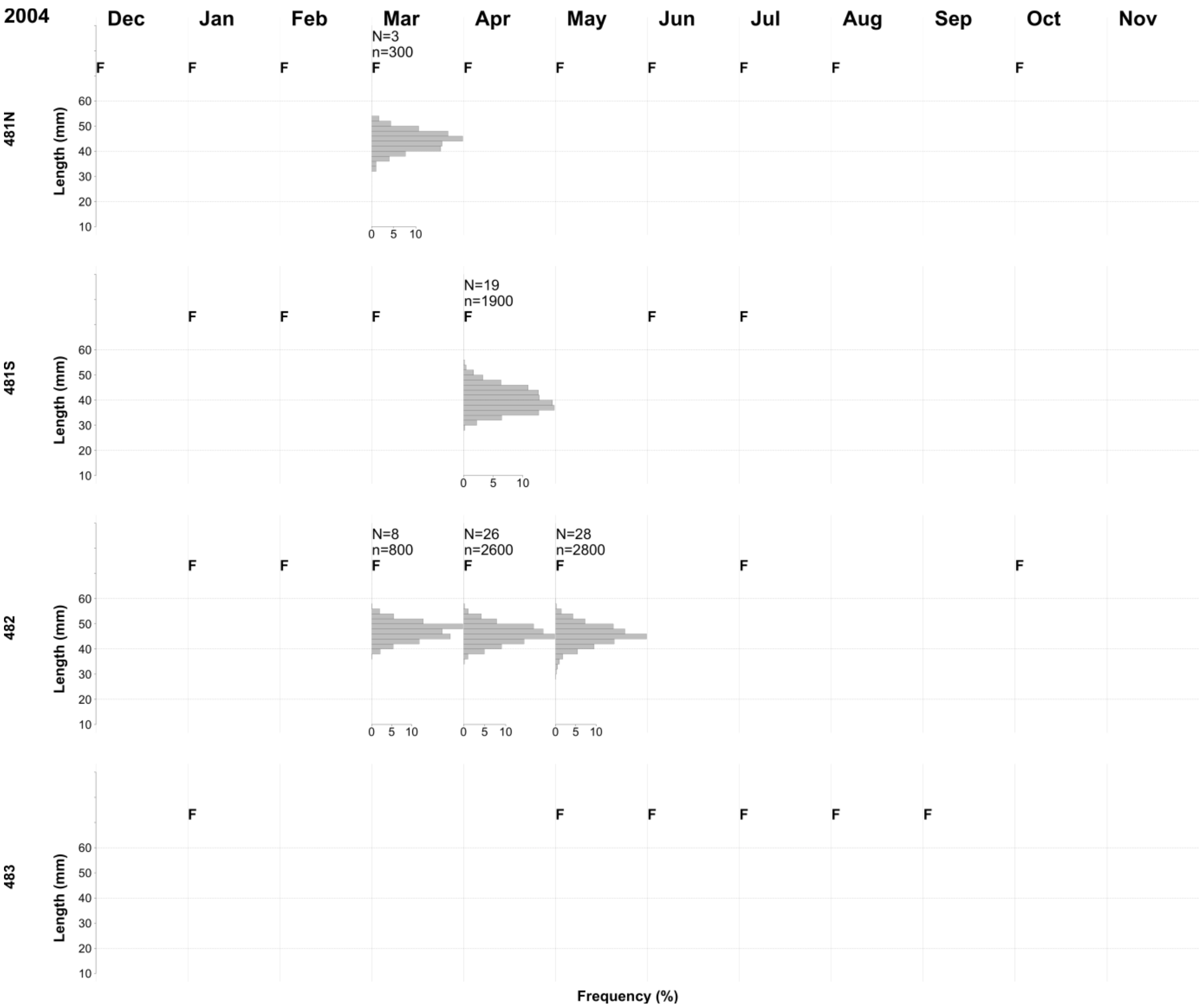

Figure A1.3: Monthly length-frequencies for krill in Subareas 48.1 (N and S), 48.2 and 48.3 in 2004. The number of hauls from which krill were measured (N) and the number of fish measured (n) in each month are provided; the months in which fishing occurred in a subarea are indicated by the letter F.

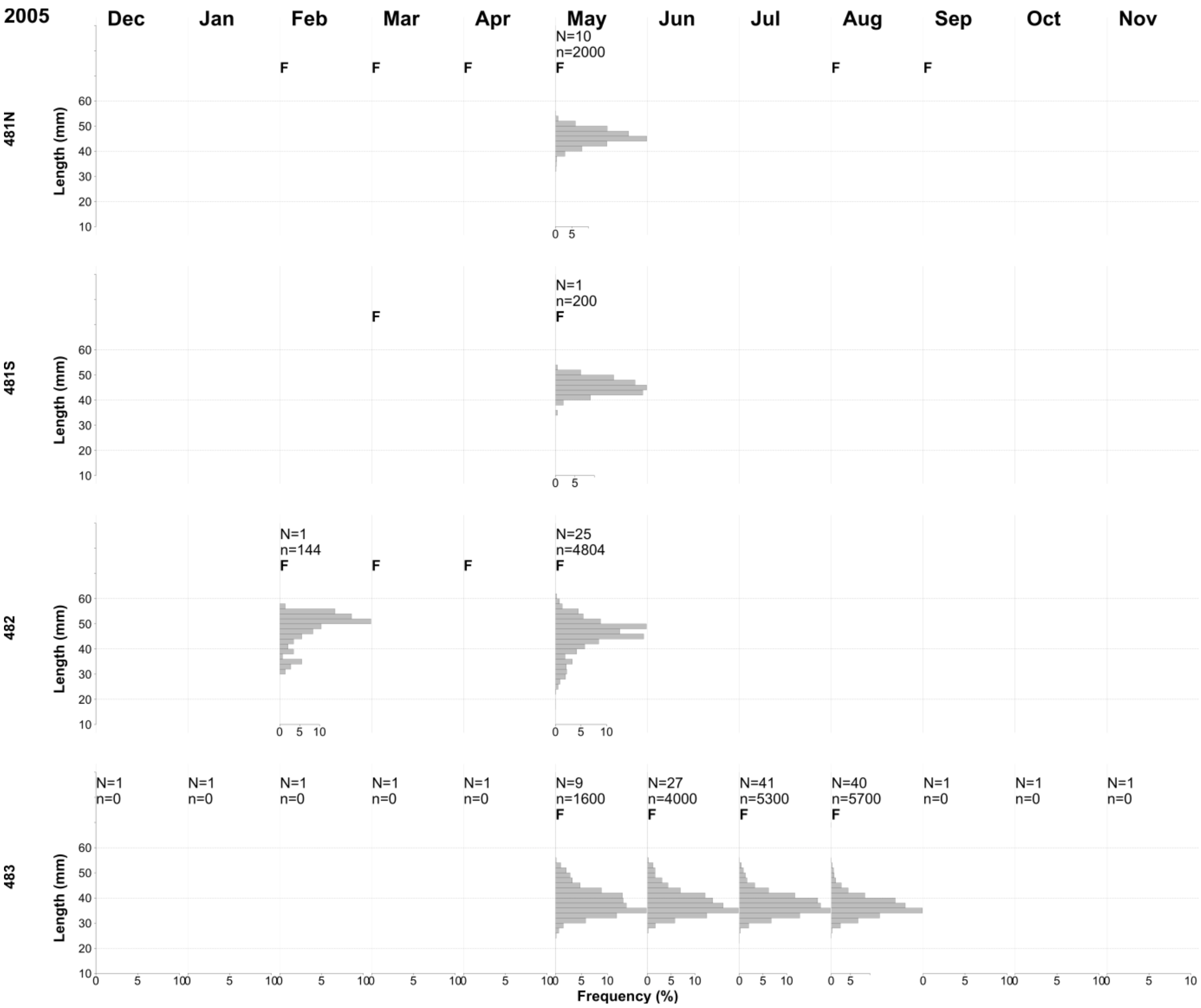

Figure A1.4: Monthly length-frequencies for krill in Subareas 48.1 (N and S), 48.2 and 48.3 in 2005. The number of hauls from which krill were measured (N) and the number of fish measured (n) in each month are provided; the months in which fishing occurred in a subarea are indicated by the letter F.

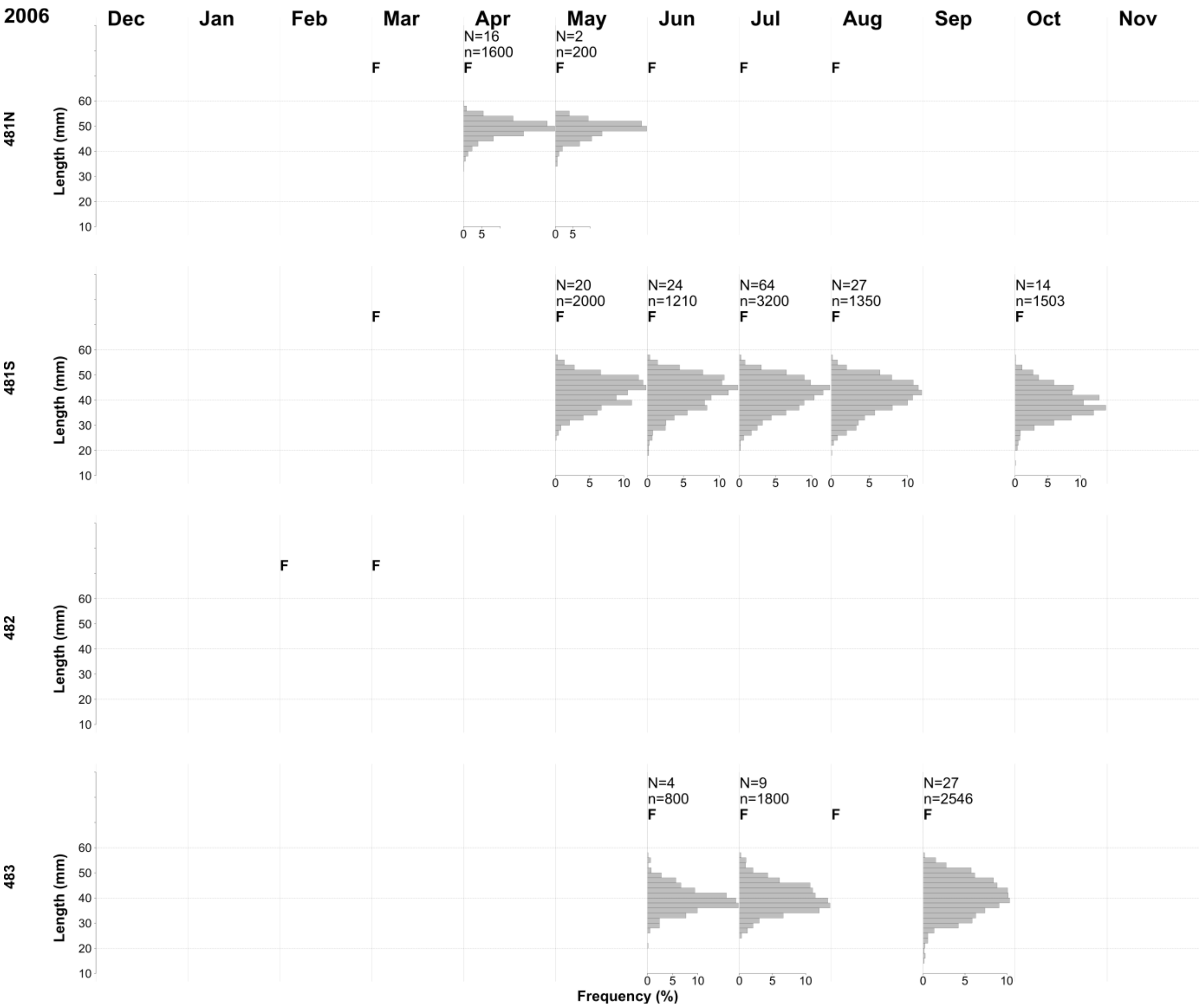

Figure A1.5: Monthly length-frequencies for krill in Subareas 48.1 (N and S), 48.2 and 48.3 in 2006. The number of hauls from which krill were measured (N) and the number of fish measured (n) in each month are provided; the months in which fishing occurred in a subarea are indicated by the letter F.

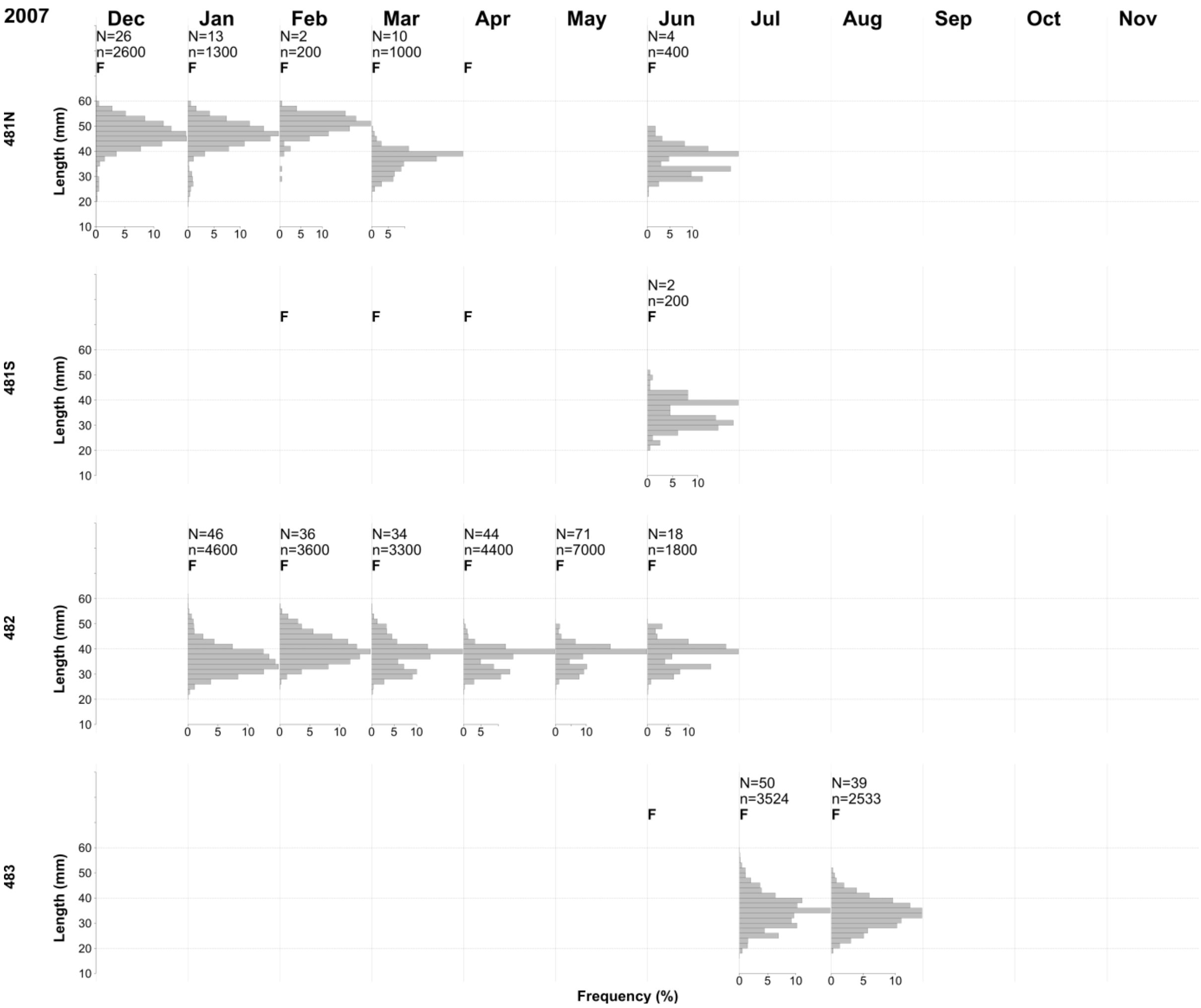

Figure A1.6: Monthly length-frequencies for krill in Subareas 48.1 (N and S), 48.2 and 48.3 in 2007. The number of hauls from which krill were measured (N) and the number of fish measured (n) in each month are provided; the months in which fishing occurred in a subarea are indicated by the letter F.

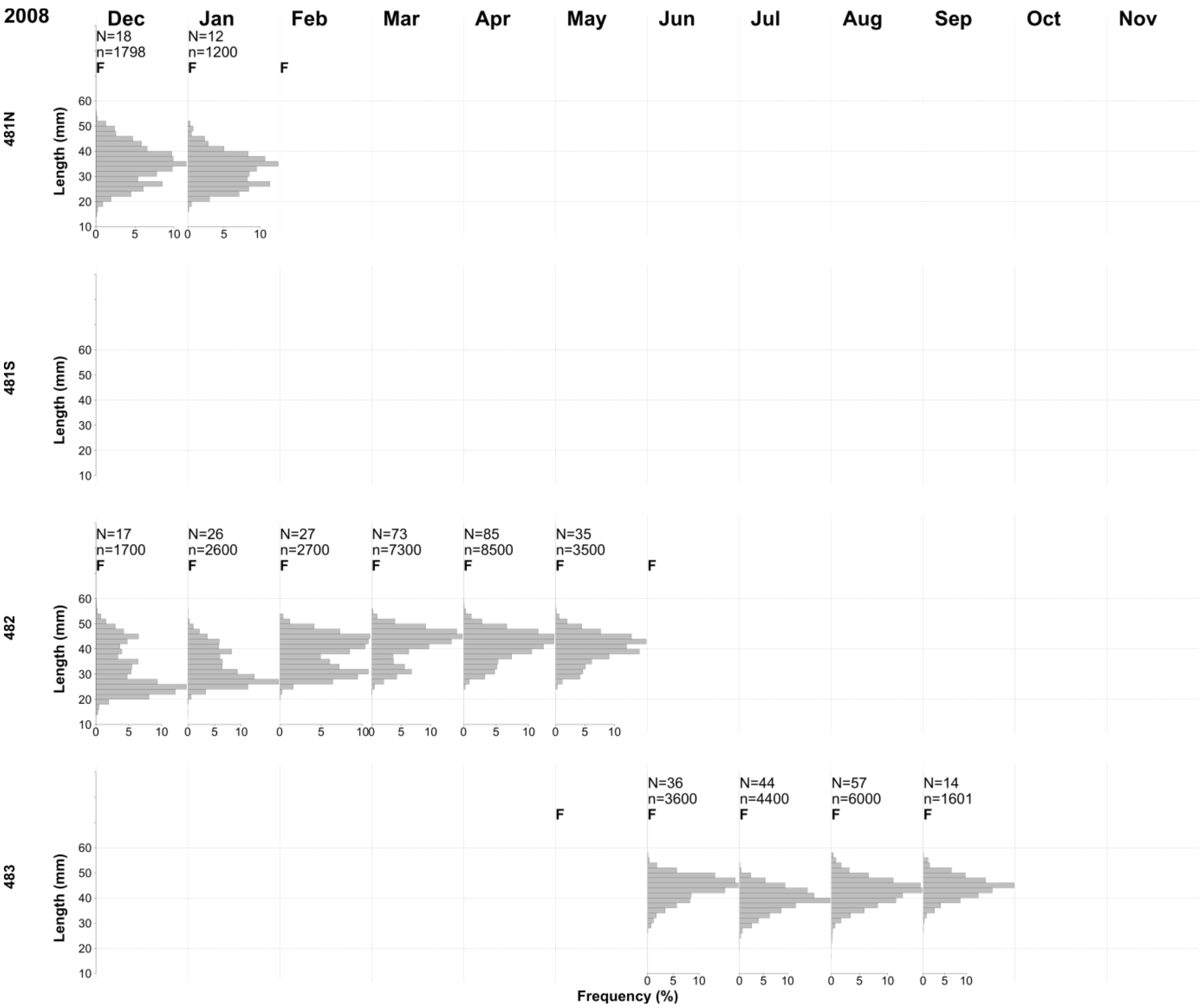

Figure A1.7: Monthly length-frequencies for krill in Subareas 48.1 (N and S), 48.2 and 48.3 in 2008. The number of hauls from which krill were measured (N) and the number of fish measured (n) in each month are provided; the months in which fishing occurred in a subarea are indicated by the letter F.

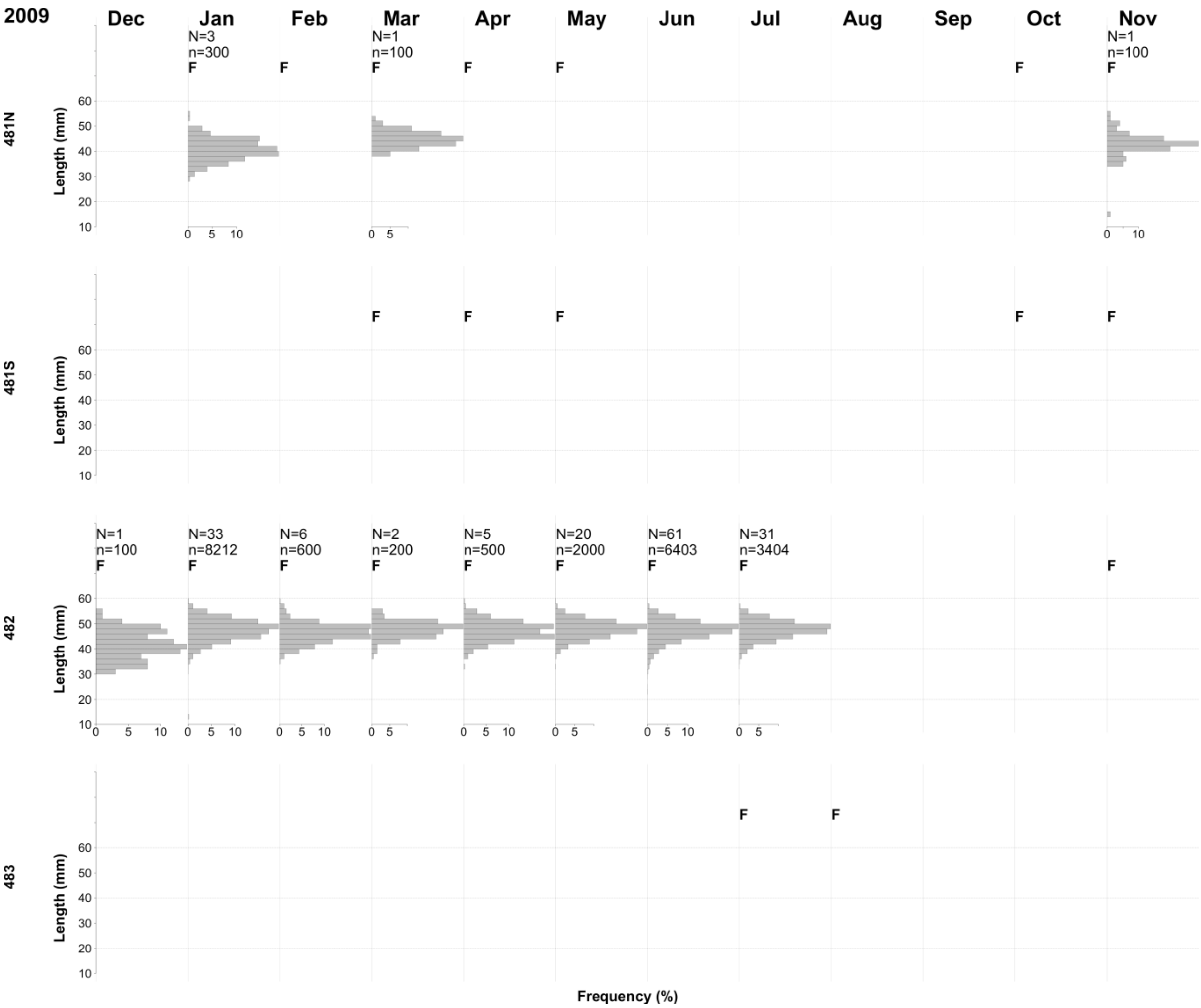

Figure A1.8: Monthly length-frequencies for krill in Subareas 48.1 (N and S), 48.2 and 48.3 in 2009. The number of hauls from which krill were measured (N) and the number of fish measured (n) in each month are provided; the months in which fishing occurred in a subarea are indicated by the letter F.

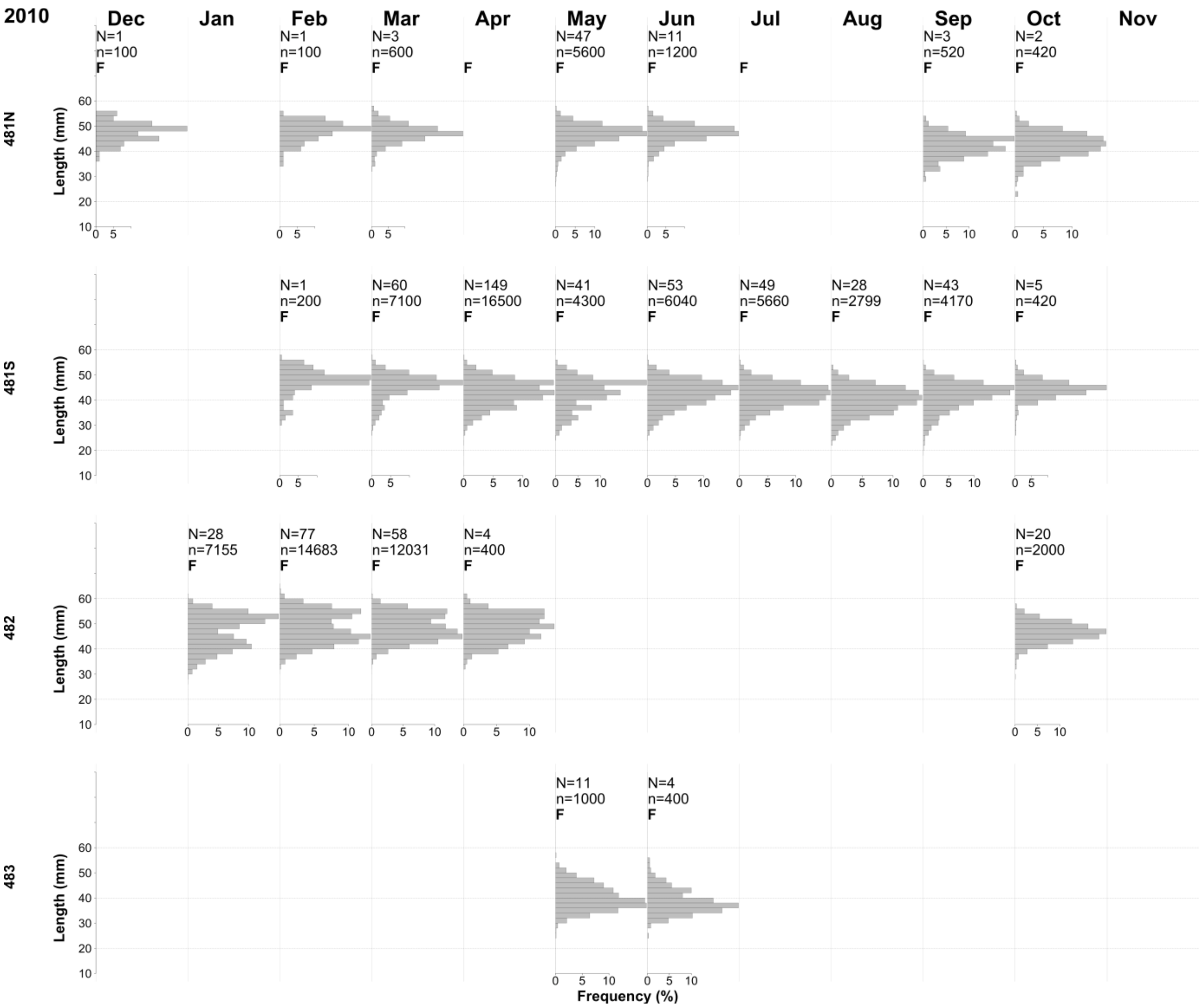

Figure A1.9: Monthly length-frequencies for krill in Subareas 48.1 (N and S), 48.2 and 48.3 in 2010. The number of hauls from which krill were measured (N) and the number of fish measured (n) in each month are provided; the months in which fishing occurred in a subarea are indicated by the letter F.

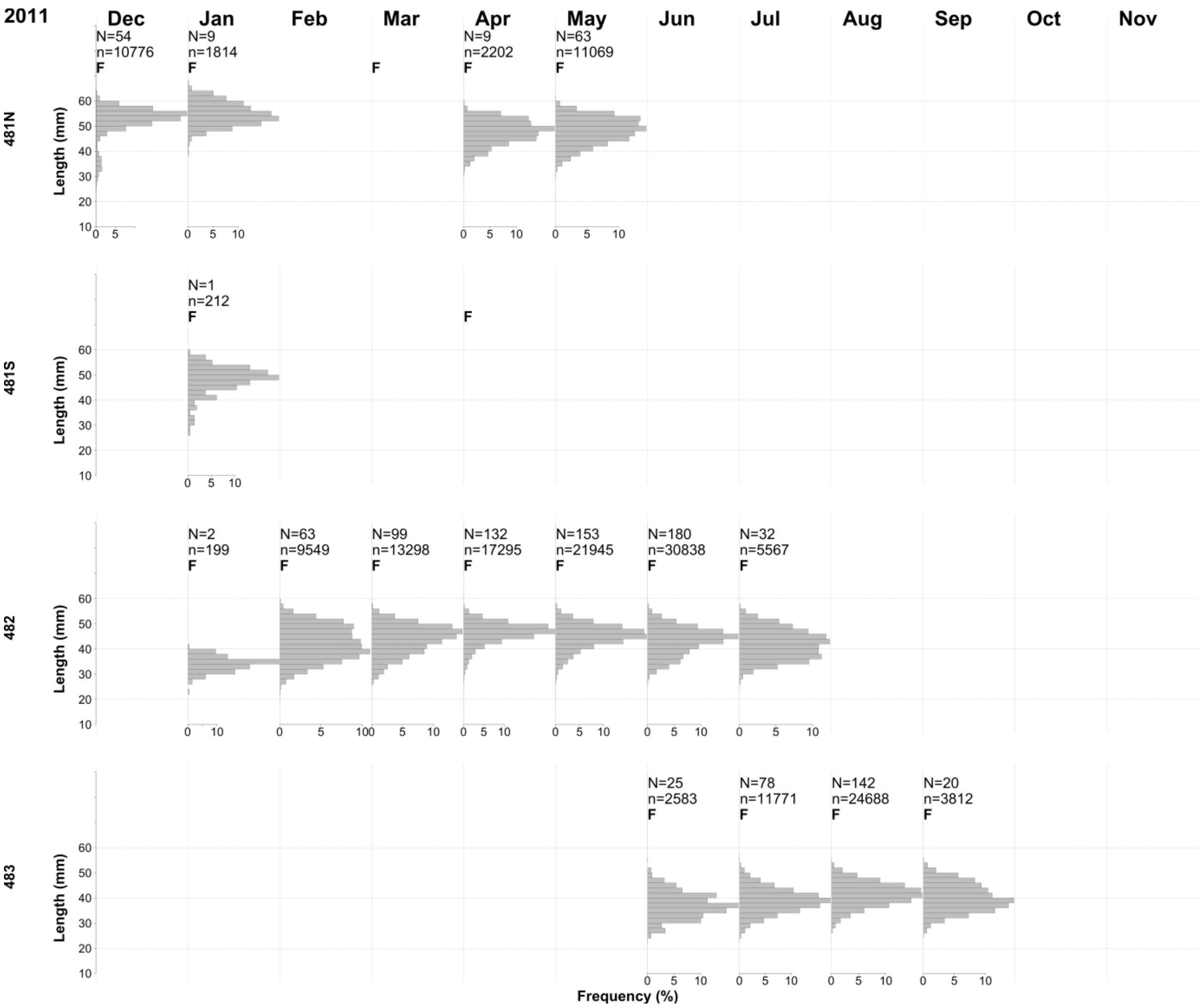

Figure A1.10: Monthly length-frequencies for krill in Subareas 48.1 (N and S), 48.2 and 48.3 in 2011. The number of hauls from which krill were measured (N) and the number of fish measured (n) in each month are provided; the months in which fishing occurred in a subarea are indicated by the letter F.

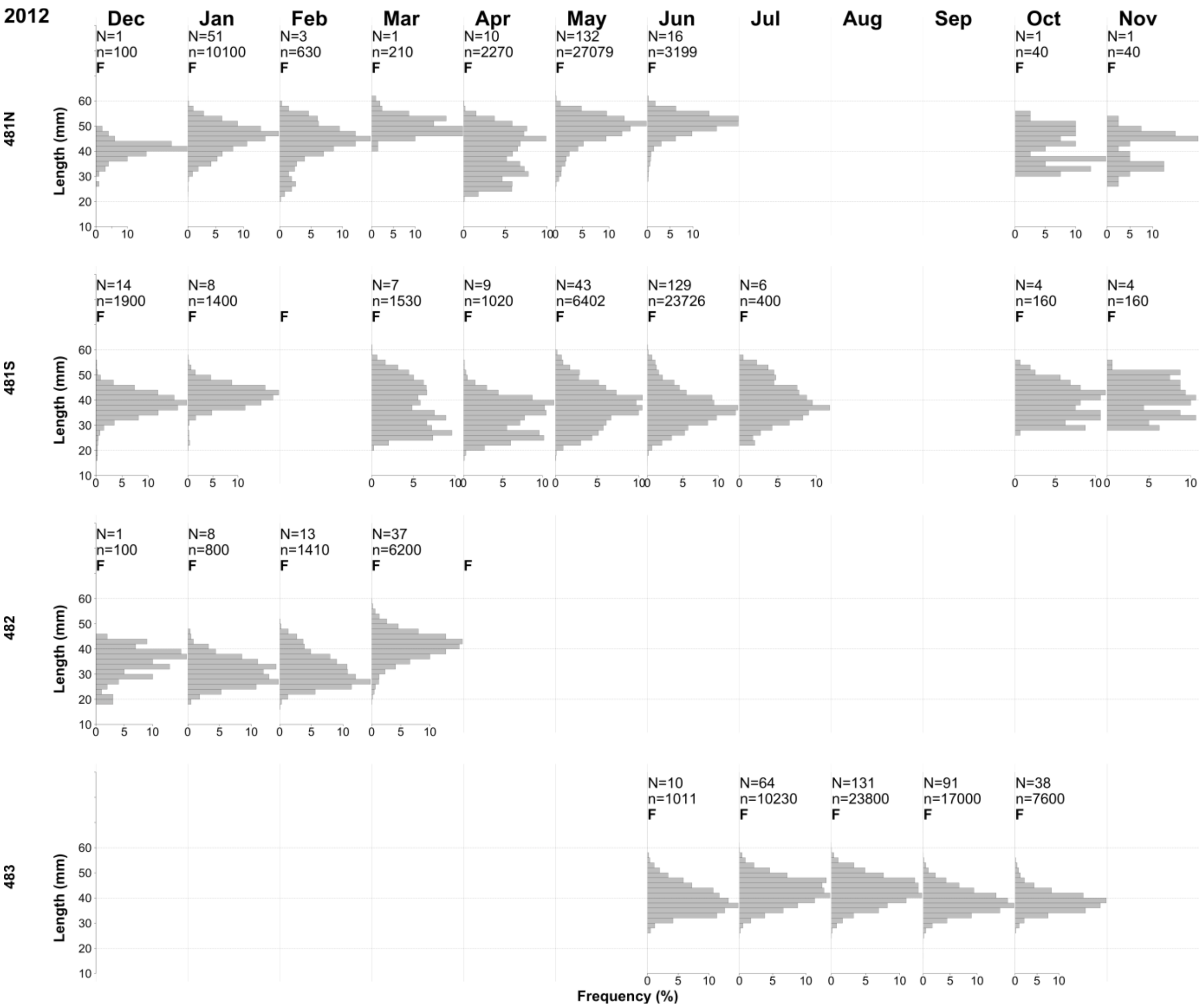

Figure A1.11: Monthly length-frequencies for krill in Subareas 48.1 (N and S), 48.2 and 48.3 in 2012. The number of hauls from which krill were measured (N) and the number of fish measured (n) in each month are provided; the months in which fishing occurred in a subarea are indicated by the letter F.

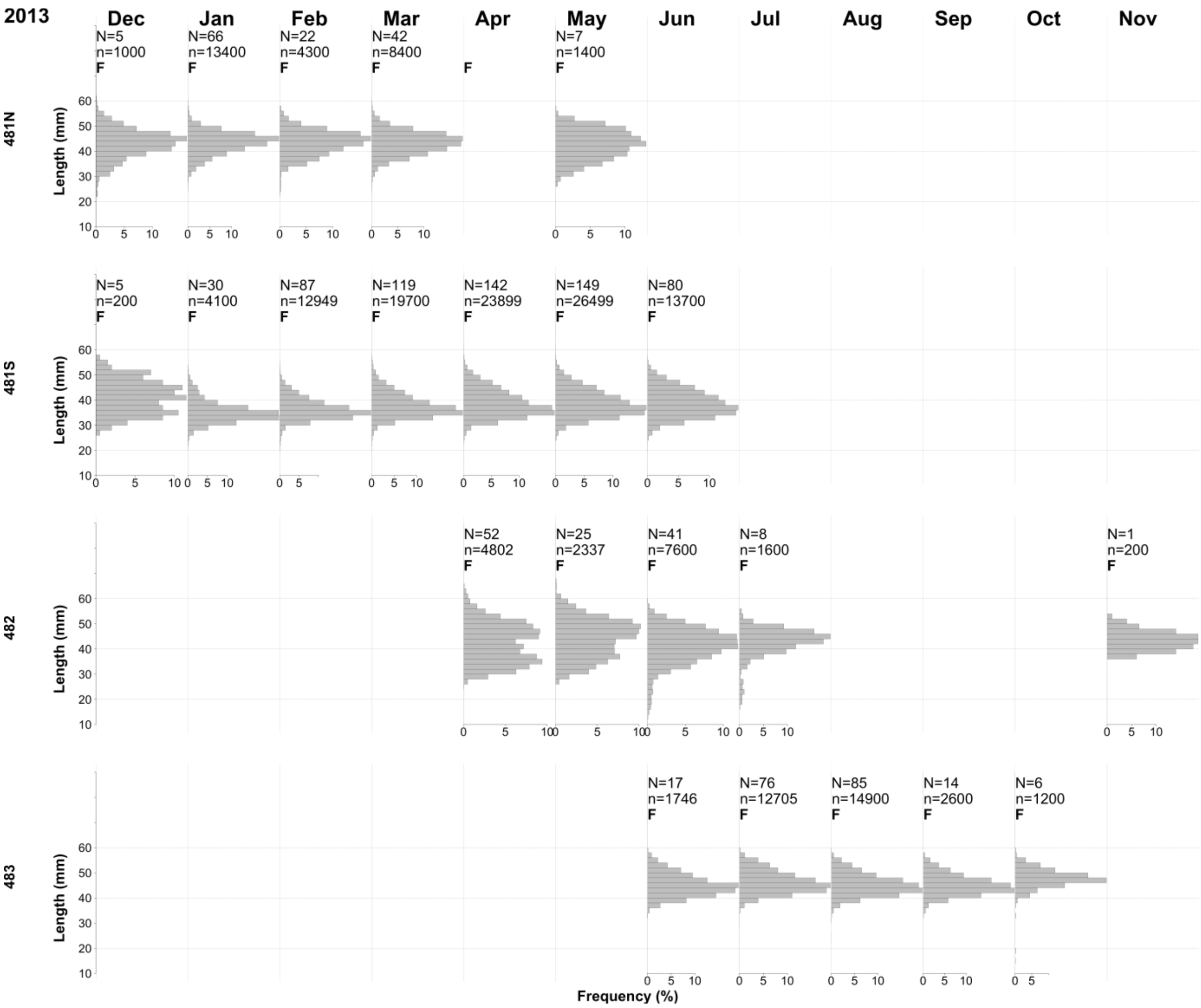

Figure A1.12: Monthly length-frequencies for krill in Subareas 48.1 (N and S), 48.2 and 48.3 in 2013. The number of hauls from which krill were measured (N) and the number of fish measured (n) in each month are provided; the months in which fishing occurred in a subarea are indicated by the letter F.

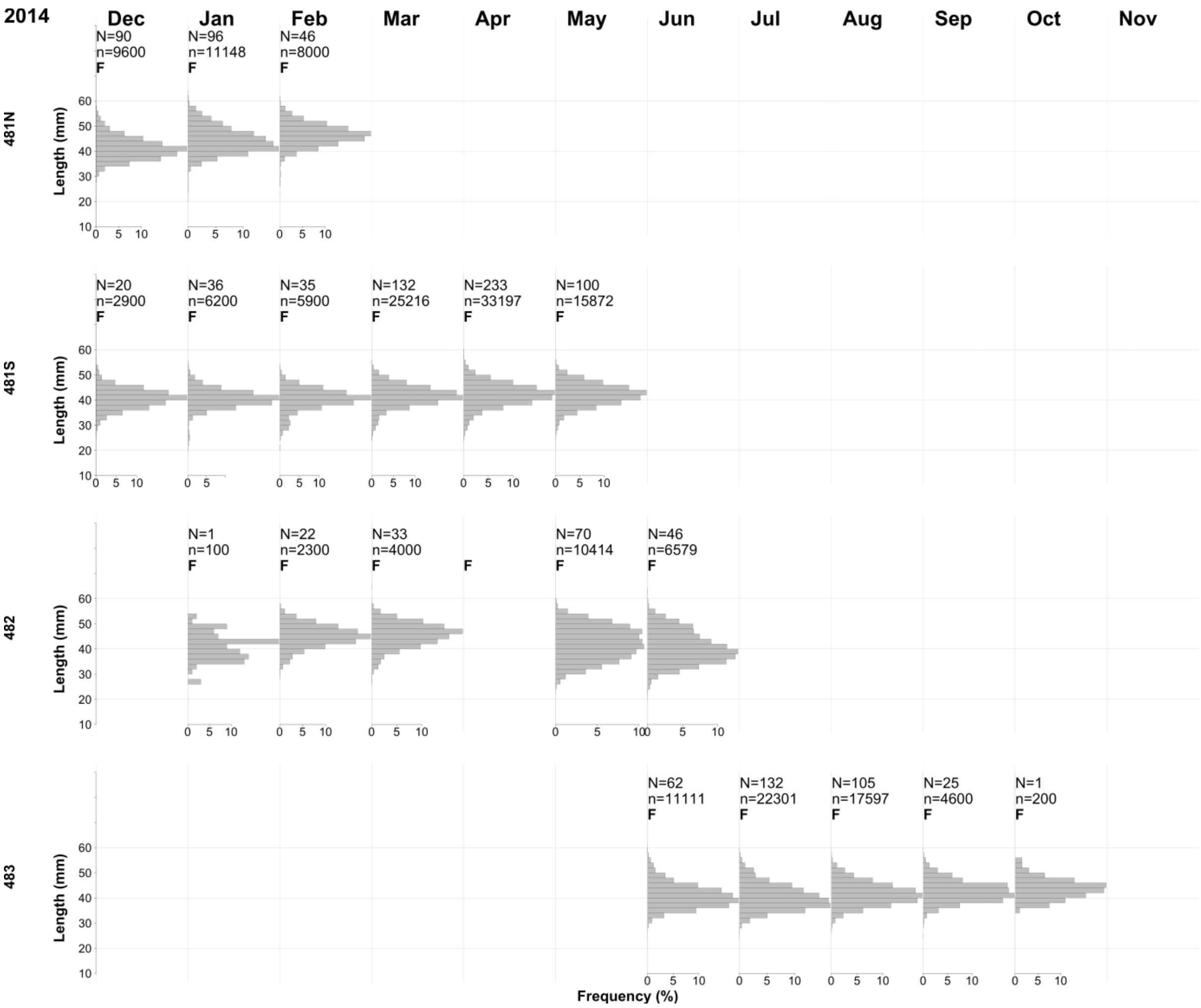

Figure A1.13: Monthly length-frequencies for krill in Subareas 48.1 (N and S), 48.2 and 48.3 in 2014. The number of hauls from which krill were measured (N) and the number of fish measured (n) in each month are provided; the months in which fishing occurred in a subarea are indicated by the letter F.

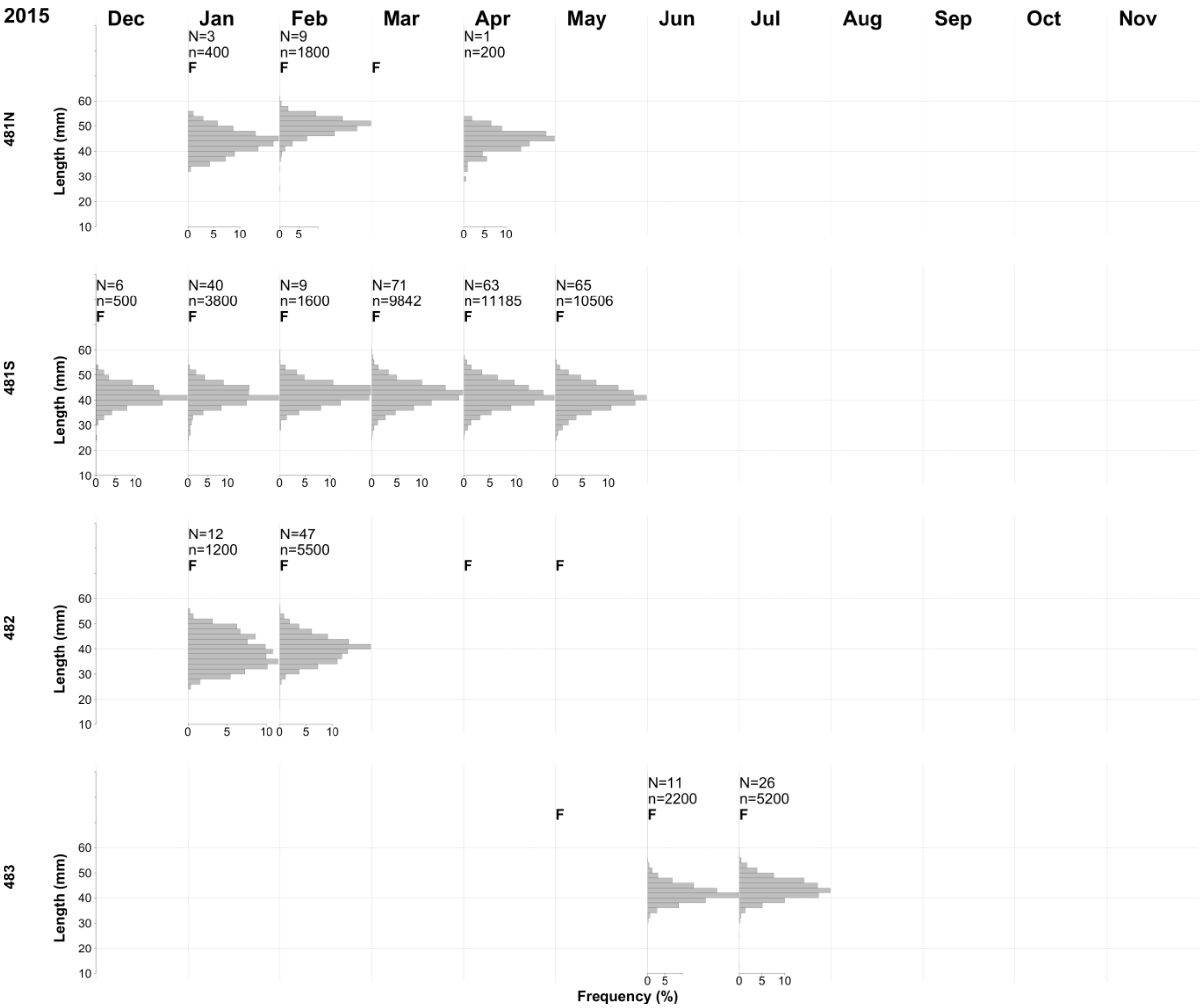

Figure A1.14: Monthly length-frequencies for krill in Subareas 48.1 (N and S), 48.2 and 48.3 in 2015. The number of hauls from which krill were measured (N) and the number of fish measured (n) in each month are provided; the months in which fishing occurred in a subarea are indicated by the letter F.

Map and catch history for SSMUs

A1. In 2003, CCAMLR agreed to the definition of a suite of small-scale management units (SSMUs) in Area 48 (Figure A2.1) that are based on the distribution of krill, krill predators and the fishery. The catches of krill in the SSMUs are given in Table A2.1.

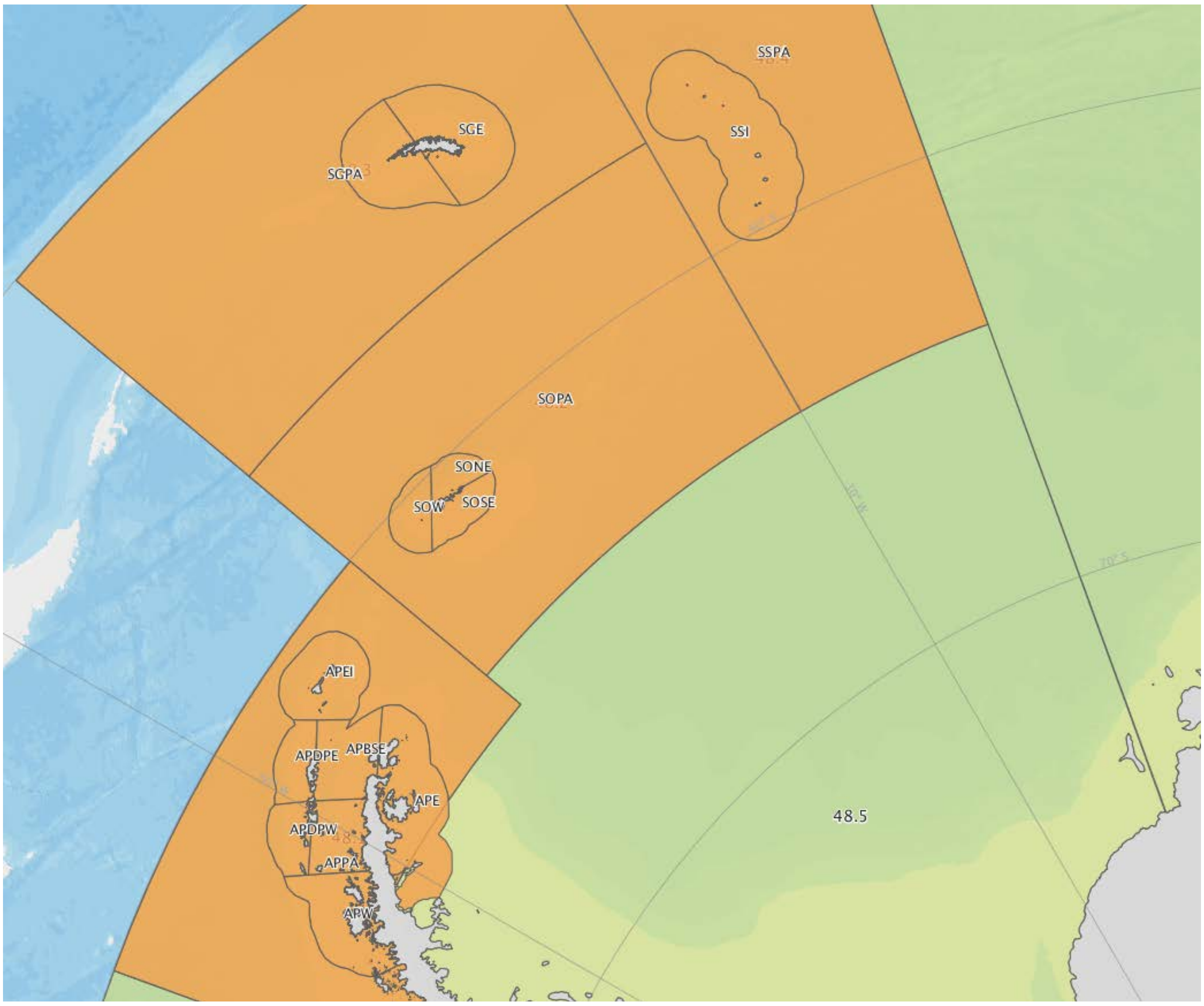

Figure A2.1: Small-scale management units (SSMUs) for the krill fishery in Area 48. Details of the labels for each SSMU are given in Table A2.1.

Table A2.1: Annual catch (tonnes) of krill from small-scale management units (SSMUs) in Area 48 reported since 1988. Antarctic Peninsula (AP) SSMUs: Pelagic Area (APPA); Bransfield Strait East (APBSE); Bransfield Strait West (APBSW); Drake Passage East (APDPE); Drake Passage West (APDPW); Antarctic Peninsula West (APW); Antarctic Peninsula East (APE); Elephant Island (APEI). South Orkney Islands (SO) SSMUs: Pelagic Area (SOPA); Northeast (SONE); Southeast (SOSE); West (SOW). South Georgia (SG) SSMUs: Pelagic Area (SGPA); East (SGE); West (SGW). (Source: C1 data scaled to catches reported in STATLANT data.)

Season	Total catch	SSMU (Subarea 48.1)								SSMU (Subarea 48.3)			SSMU (Subarea 48.2)					
		APBSE	APBSW	APDPE	APDPW	APE	APEI	APPA	APW	SGE	SGPA	SGW	SONE	SOPA	SOSE	SOW	484	486
1988	388953		43	10482	41675		24643	2045	30	105990	105636	24	4350	4716	19264	69950		104
1989	352271		21	10065	47176		42857	5401	33	157204	1412		14	72890		15197		
1990	376099	11		11432	7336		24894	1071	8	89225	11359	7230	12657	81808		129067		
1991	331318	1014	437	8245	26272		29684	4012	1	85719	8352	7598	12947	5051	201	141785		
1992	257663	92	451	9031	54004		6266	5703	18	47805	1136	15305	3870	48696		65236	50	
1993	60783		45	531	30322		2368	37	3	3482	125	11152	4245	1249		7191		33
1994	84645		146	708	26569		17652	5	4	19908	381	11	147	4	1303	17806		
1995	134420		399	2646	13834		15030	6256		46624	473	325	1273	27	24	47509		
1996	91150		1470	4149	37701	25	12613	6007		23596	63	2793	4	51		2679		
1997	75653	13	211	15656	22646		9138	1179		26605		106	91			8		
1998	90024	86	2162	18054	23602		5828	3953	2889	22930	314	3532	290	505		5877		
1999	100972	914	107	10546	11462		8976	2980	3909		985[a]		3379	984	12422	45291		
2000	114425	2934	6133	19977	30816		10673	1344	101	14600	8425	2532	1130	3145	1493	11123		
2001	104182	611	3349	16269	21803		4131	5	611	36339	620	15464	22		3848	1111		
2002	125987	57	328	1248	4834		4038	138	3	30560	3205	9517	3855	70	1170	66964		
2003	117728	18	390	1628	32189		1040	51	62	52005	791	14128	54	498	44	14831		
2004	118166	1683	385	1299	4520		5466	309	220	23508	199	34122	764	288	49	45355		
2005	129026		47	1966	5035		38	9		48107	22	308	2068	53	104	71270		
2006	106549	22796	13203	9671	40976		2148		40	6537		8077	218		7	2878		
2007	104586	22	649	2385	13959		1366	33	5	17332	36	3208	3291	10		62290		
2008	156521			126	244		2514			23369		36884	188		12	93185		
2009	125826	19906	706	1617	3325	3055	3866	1494		0		0	877	1653		89325		
2010	211974	37650	85764	4768	17295		1760	67	5958	8712			74	1266	216	48444		
2011	181011	115	59	7975	649		15	392	10	53130		2671	3836	491	196	111472		
2012	161085	4666	28657	4870	20424		72	11	16930	50218	140	6057	166	43		28832		
2013	217357	18129	110263	7749	3815		263	83	13528	28782		3439	4	34		31267		
2014	293814	58874	52881	7307	19598		675	113	6744	75169			2525			69930		
2015	225646	36747	71988	2970	347		5655		36470	54368			2933	8		14160		

[a] C1 data are not available and the catch cannot be resolved at the level of an individual SSMU.