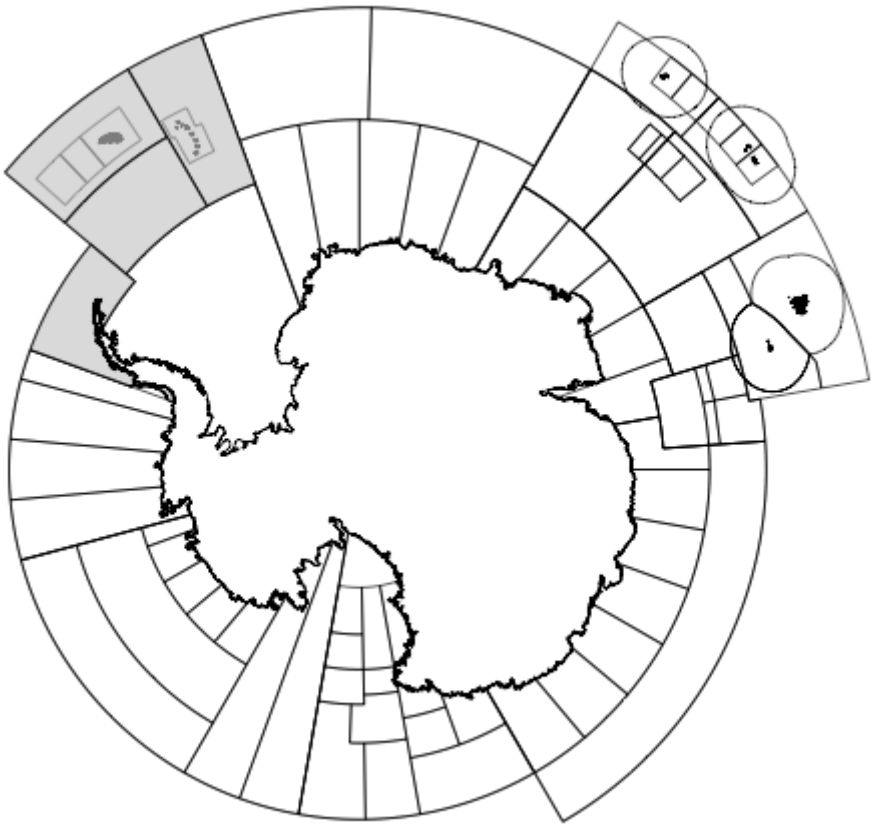
CCAMLR

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

FISHERY REPORT

# Krill Fishery Report 2018



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 2018

## 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).

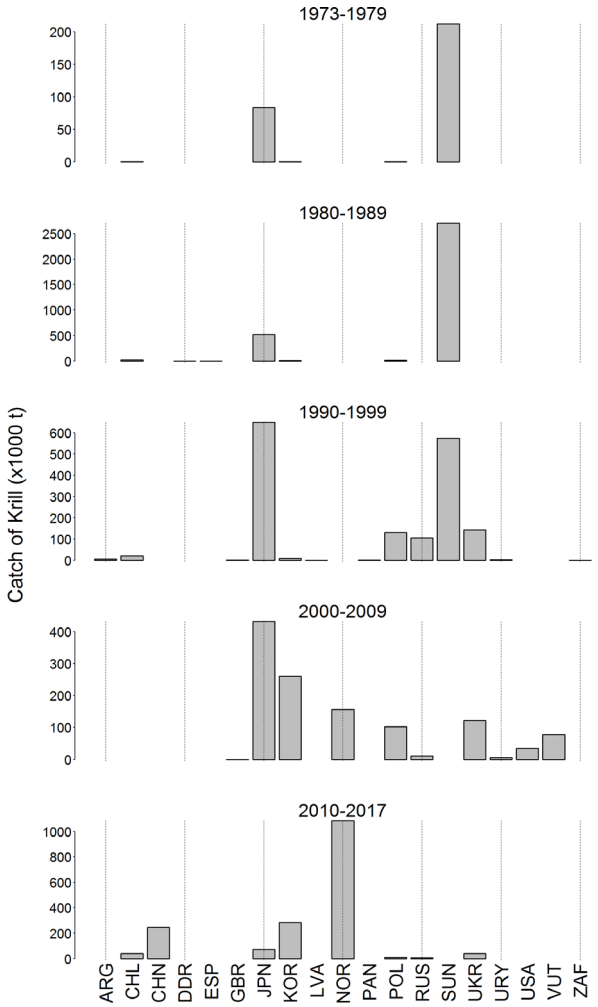



Figure 1: Catches of krill in the CAMLR Convention Area reported by Argentina (ARG), Chile (CHL), China (CHN), German Democratic Republic (DDR), Spain (ESP), United Kingdom (GBR), Japan (JPN), Republic of Korea (KOR), Latvia (LVA), Norway (NOR), Panama (PAN), Poland (POL), Russian Federation (RUS), USSR (SUN), Ukraine (UKR), Uruguay (URY), United States of America (USA), Vanuatu (VUT) and South Africa (ZAF). (Source: *Statistical Bulletin* and C1 data for most recent season – 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.

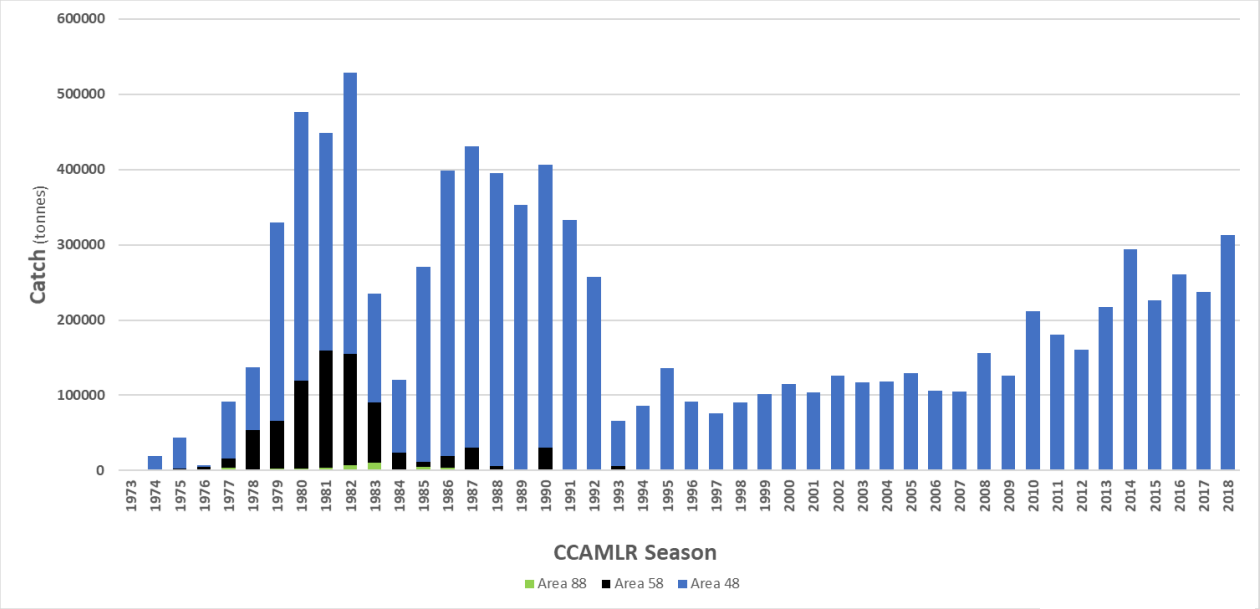



Figure 2: Total annual catches of krill (*Euphausia superba*) in the CAMLR Convention Area. (see: www.ccamlr.org/node/74620.)

3. The CCAMLR database holds data on krill catches starting in 1973. The majority of the catch was reported by the USSR (41%) and Japan (21%) with Norway (17%) and Korea (7%) the other fishing nations with more than 5% of the catch. The only CCAMLR Members that have fished for 20 years or more are Japan (40 years), Korea (31 years), Poland (29 years) and Chile (20 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). In the period 2008–2018 eight Members have fished for krill, 59% of the total catch has been taken by Norway, 17% by Korea and 12% by China.

4. 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. Both this fishing method and the traditional trawling continue to be used in the krill fishery.

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).

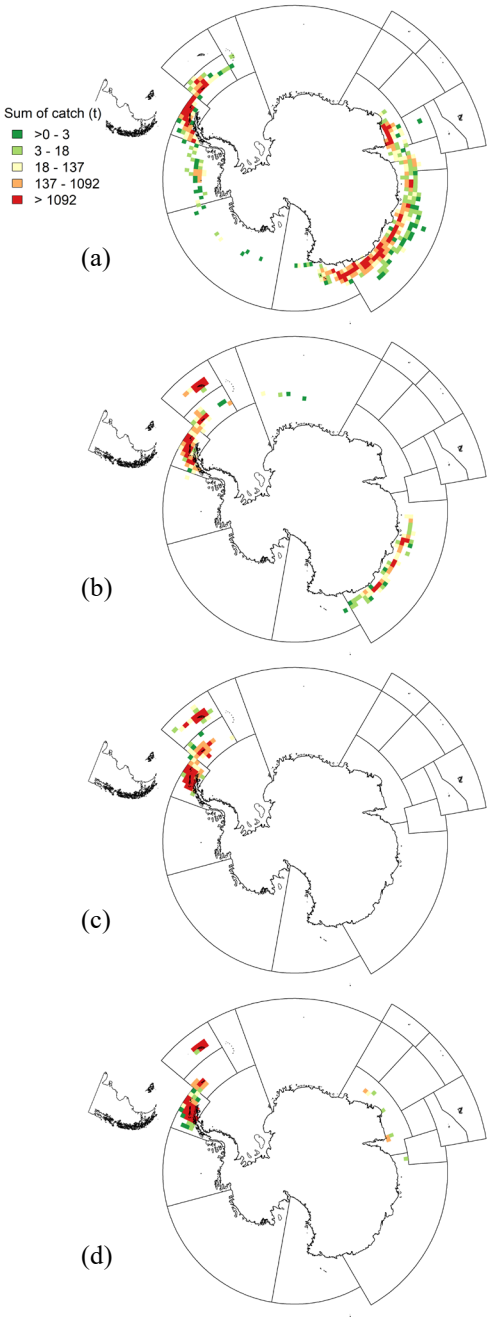



Figure 3: The spatial distribution of catches in the krill fishery reported to CCAMLR aggregated by 1° latitude by 2° longitude cells for (a) 1980 to 1989, (b) 1990 to 1999, (c) 2000 to 2009, and (d) 2010 to present.

6. Given the geographic focus of the krill fishery in recent decades, the remainder of this report is focussed on Area 48. 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 was no commercial krill fishing in these two divisions between 1991 and 2016. One vessel fished for krill in Divisions 58.4.1 and 58.4.2 in 2017.

## 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, 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 the period that the net is in the water.

#### Reported catch in 2017 and 2018

9. In 2017, 11 vessels fished in at least one of the three Subareas 48.1, 48.2 and 48.3; the total catch of krill was 236 938 tonnes; one vessel fished for krill in Divisions 58.4.1 and 58.4.2 and caught a total of 513 tonnes (Table 1).

Table 1: Catch (tonnes) of krill reported from the fishery in in 2017.

| Month | Subarea/Division | | | | | Total |
|---|---|---|---|---|---|---|
| | 48.1 | 48.2 | 48.3 | 58.4.1 | 58.4.2 | |
| December | | 8311 | | | | 8311 |
| January | 2548 | 23319 | | | | 25867 |
| February | 5263 | 21833 | | 9 | 504 | 27609 |
| March | 15788 | 14616 | | | | 30404 |
| April | 43155 | | | | | 43155 |
| May | 38638 | | | | | 38638 |
| June | 31349 | | | | | 31349 |
| July | 12594 | 966 | 7717 | | | 21277 |
| August | | | 10323 | | | 10323 |
| September | | | 518 | | | 518 |
| Total | 149335 | 69045 | 18558 | 9 | 504 | 237451 |

10. In 2018, nine vessels fished in at least one of the three Subareas 48.1, 48.2 and 48.3; the total catch of krill was 312 743 tonnes; two vessels fished for krill in Division 58.4.2 and caught a total of 246 tonnes (Table 2).

Table 2: Catch (tonnes) of krill reported from the fishery in 2018

| Month | Subarea/Division | | | | Total |
|---|---|---|---|---|---|
| | 48.1 | 48.2 | 48.3 | 58.4.2 | |
| December | 204 | 23003 | | | 23207 |
| January | 728 | 28911 | | 246 | 29885 |
| February | 6516 | 31225 | | | 37741 |
| March | 27082 | 12971 | | | 40053 |
| April | 36602 | 2597 | | | 39199 |
| May | 45544 | 404 | | | 45948 |
| June | 35016 | 1767 | | | 36783 |
| July | | 135 | 9687 | | 9822 |
| August | | 2820 | 11909 | | 14729 |
| September | | 28088 | 1577 | | 29665 |
| October | | 5957 | | | 5957 |
| Total | 151692 | 137878 | 23173 | 246 | 312989 |

11. In 2018, more fishing took place in Subarea 48.2 than in previous years and in particular in the period July to October, fishing took place in September for the first time in the this subarea. Both the catch taken in Subarea 48.2 and the overall catch were the highest since 1991. Fishing operations peaked in Subarea 48.1 from April to June until the closure of the fishery in that subarea on 25 June 2018. As in previous years, fishing in Subarea 48.3 occurred during the period from June to September (Tables 1 and 3).

**Scientific observer data reporting**

12. 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.

13. 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 2010–2017, shows the increase in observer coverage over time with many subareas routinely achieving 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.

Table 3: Observer coverage, the total number of days with an observer was on board a krill fishing vessel as a percentage of the total number of days fished (by all vessels), in Subareas 48.1, 48.2 and 48.3 from 2006 to 2018. Note that the data for 2018 are incomplete and reflect observer data received by 31 December 2018.

| Season | Subarea | | |
|---|---|---|---|
| | 48.1 | 48.2 | 48.3 |
| 2006 | 16 | 0 | 48 |
| 2007 | 17 | 36 | 31 |
| 2008 | 84 | 36 | 36 |
| 2009 | 8 | 54 | 100 |
| 2010 | 64 | 86 | 100 |
| 2011 | 81 | 77 | 96 |
| 2012 | 76 | 65 | 100 |
| 2013 | 96 | 82 | 62 |
| 2014 | 87 | 95 | 100 |
| 2015 | 89 | 92 | 100 |
| 2016 | 100 | 100 | 86 |
| 2017 | 63 | 87 | 86 |
| 2018 | 99 | 86 | 95 |

14. 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).

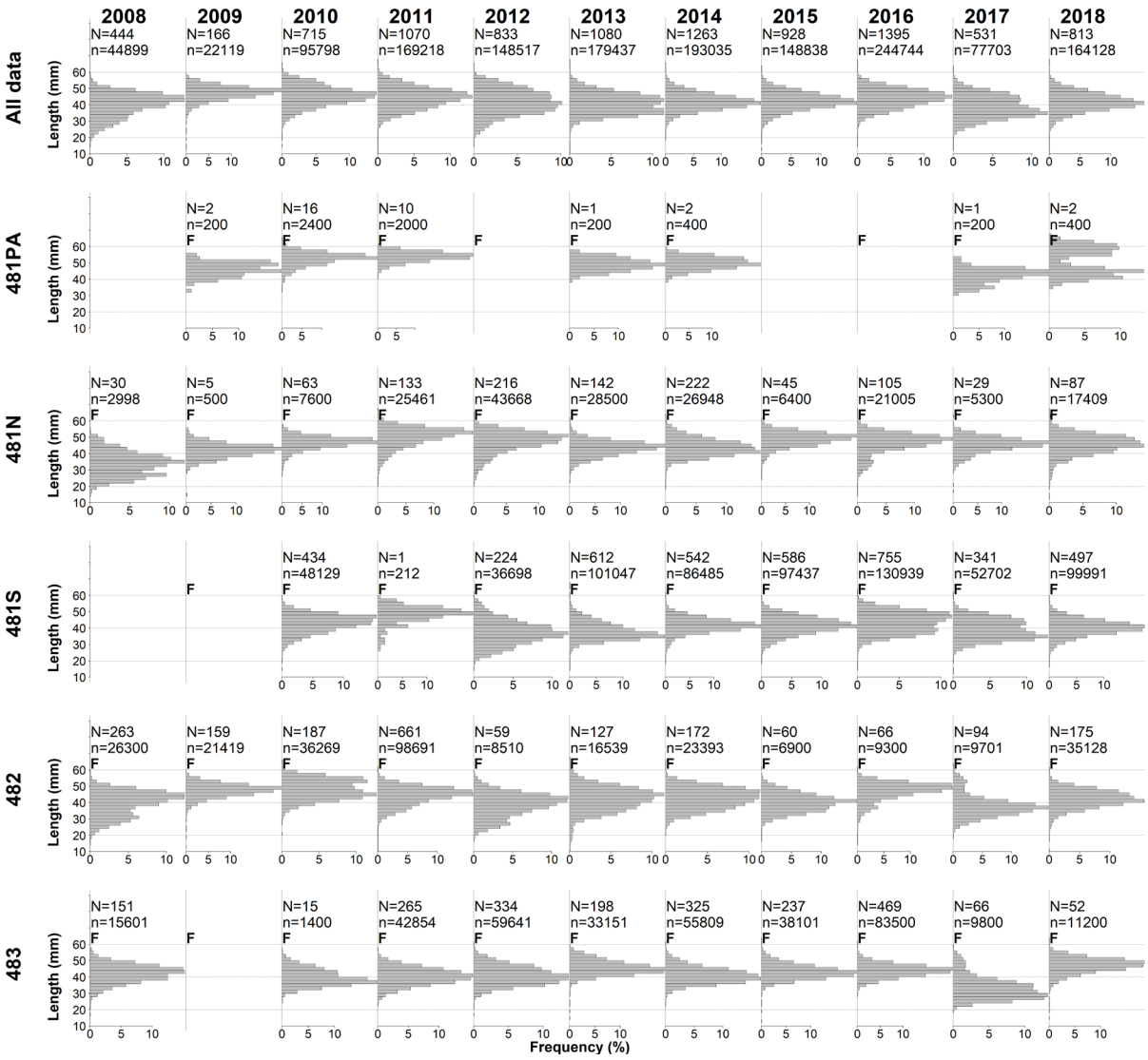



Figure 4: Annual length-frequency distributions for krill, presented by fishing season from 2008 to the present season, in Area 48 (top panel) and in Subareas 48.1 (PA, N and S see Figure 5), 48.2 and 48.3 (lower panels). The number of hauls from which krill were measured (N) and the number of individuals measured (n) in each year are provided; the months in which fishing occurred in a subarea are indicated by the letter F.

15. 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).

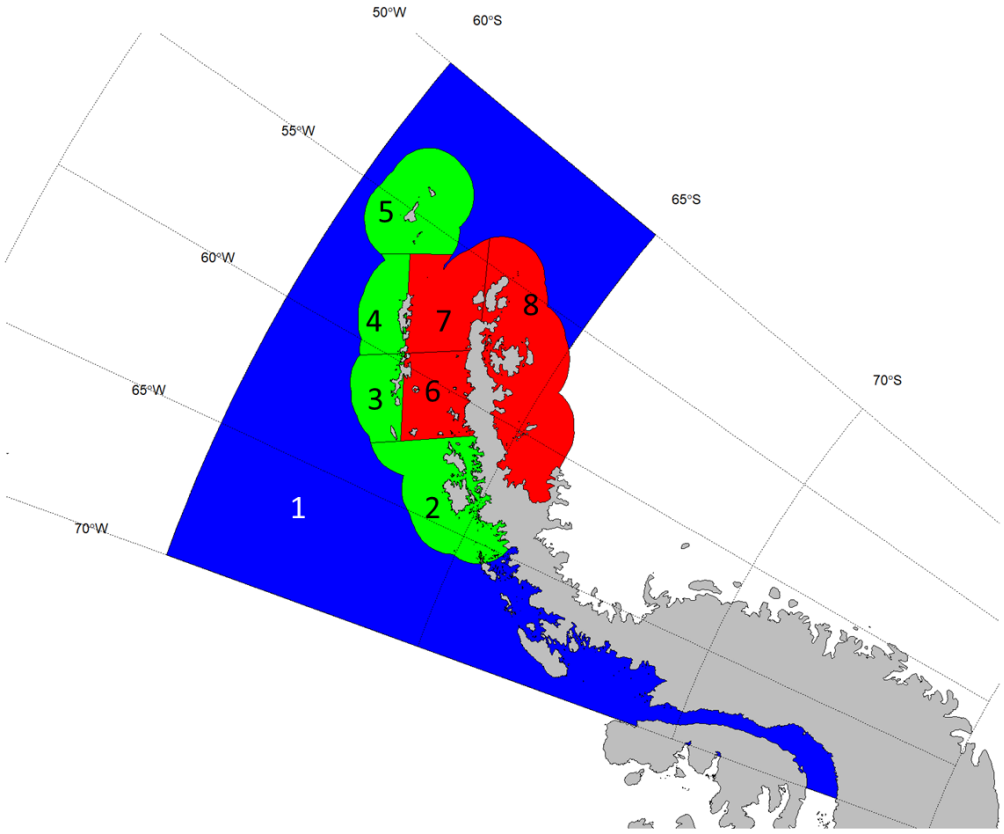



Figure 5: Small-scale management units (SSMUs) in Subarea 48.1: 1. Pelagic Area (APPA), 2. Antarctic Peninsula West (APW), 3. Drake Passage West (APDPW), 4. Drake Passage East (APDPE), 5. Elephant Island (APEI), 6. Bransfield Strait West (APBSW), 7. Bransfield Strait East (APBSE), 8. Antarctic Peninsula East (APE). These are grouped into 481PA(1, blue), 481N(2, 3, 4 and 5, green) and 481S (6, 7 and 8, red) for the aggregation of length-frequency distributions of krill (following the recommendation of WG-EMM-15 – SC-CAMLR-XXXIV, Annex 6, paragraph 2.10).

16. The length-frequency distributions by month and subarea for the most recent complete season, 2017, are shown in Figure 6 and for all data available for 2018, are shown in Figure 7. The month by subarea length-frequency distribution plots for all fishing seasons from 2001 to 2016 are provided in Appendix 1.

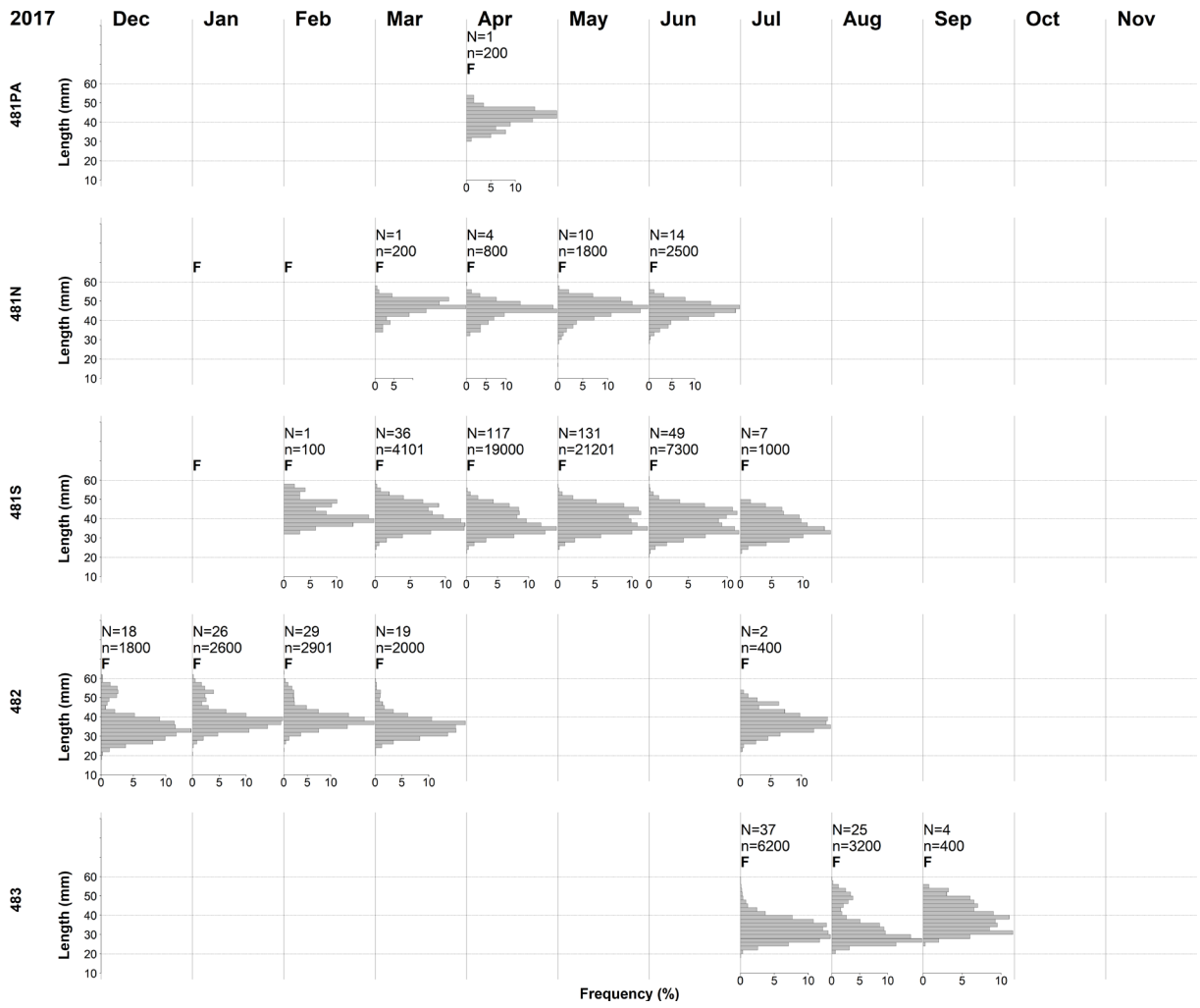



Figure 6: Monthly length-frequency distributions for krill in Subareas 48.1 (including PA, N and S), 48.2 and 48.3 in 2017. The number of hauls from which krill were measured (N) and the number of individuals measured (n) in each month are provided; the months in which fishing occurred in a subarea are indicated by the letter F.

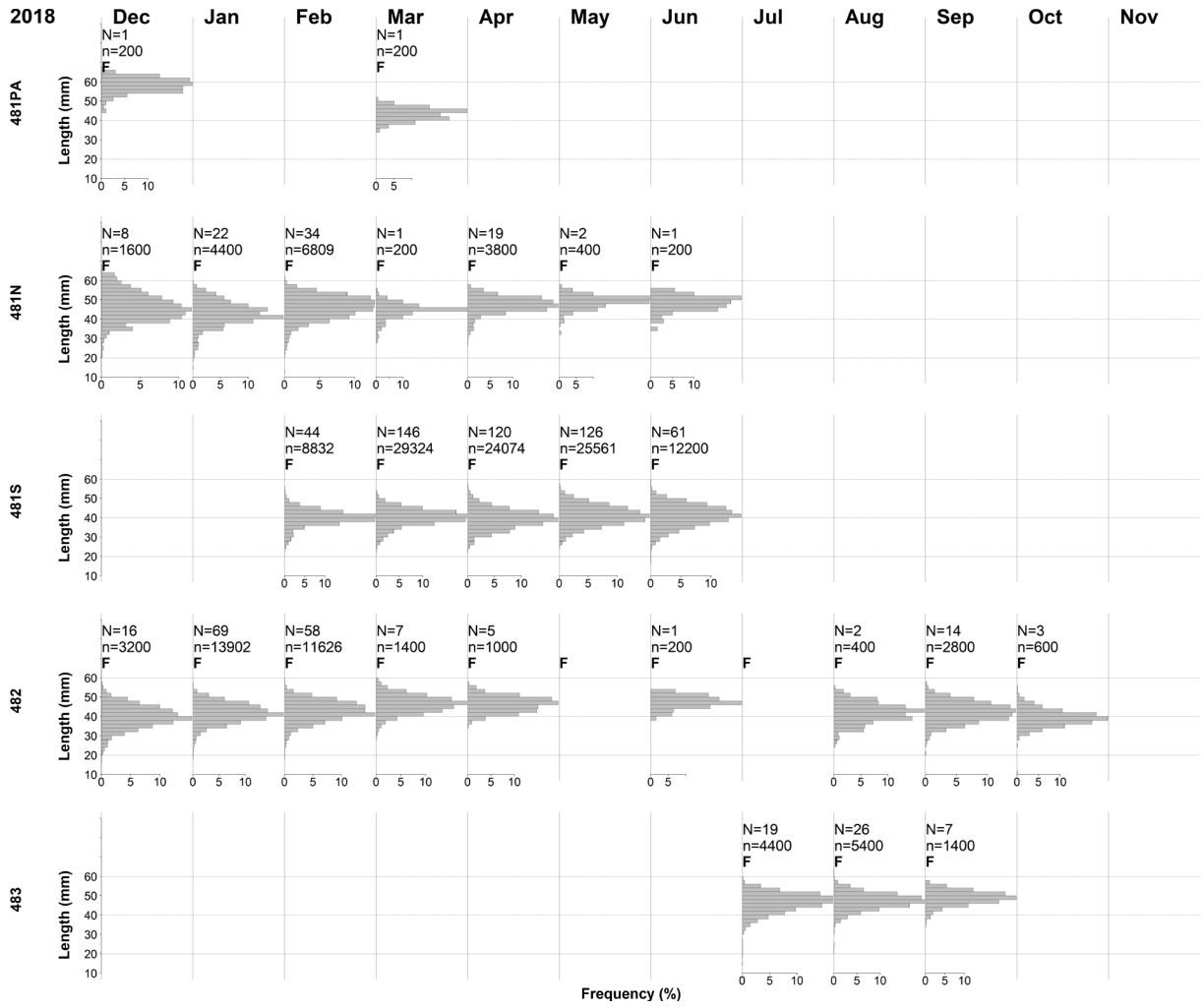



Figure 7: Monthly length-frequency distributions for krill in Subareas 48.1 (including PA, N and S), 48.2 and 48.3 in 2018. The number of hauls from which krill were measured (N) and the number of individuals measured (n) in each month are provided; the months in which fishing occurred in a subarea are indicated by the letter F.

## Non-target catch

### Fish by-catch

17. There are no by-catch limits in place for the krill fishery, however, fish by-catch data are available from vessel-reported haul-by-haul data as well as from observer data. Detailed information on the fish by-catch reported from the krill fishery was provided in WG-FSA-18/10. SISO observers collect a 25kg sample of krill from a point on the vessel where no pre-sorting of the catch has occurred for a subset of hauls. They then remove all fish from that sample identify them to the most specific taxonomic level, record the total length for each fish and the total mass for each taxa. The total by-catch by species in the haul-by-haul data are reported in the 'fine-scale catch and effort (C1)' forms as specified in CM 23-04.

18. The relative frequency of fish by-catch in the C1 data has shown an increase in recent years, whereas the frequency of occurrence in the SISO data has remained relatively consistent since 2012, albeit with a reduction in the quartile ranges (Figure 8). There is a high degree of overlap in the most frequently reported taxa in the C1 data and SISO data, with painted rockcod (*Lepidonothen larseni*) the most frequently reported in both datasets

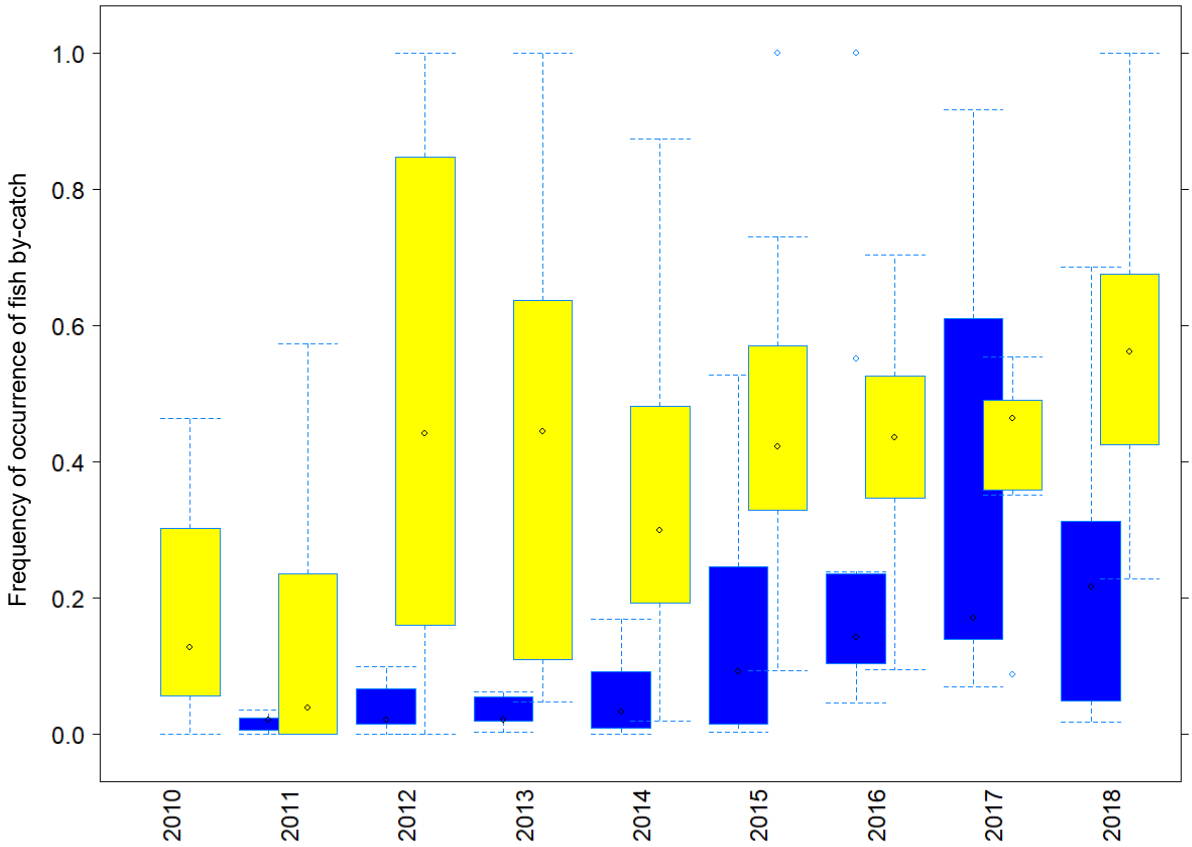



Figure 8: The frequency of occurrence of fish by-catch reported in the C1 (blue) the SISO (yellow) data from 2010 to 2018.

19. The spatial distribution of the most frequently occurring by-catch taxa indicates that they can be considered in three general groups, that include those taxa that are:

(i) restricted to Subarea 48.1 with rare occurrences in Subarea 48.2 (spiny icefish – *Chaenodraco wilsoni*)

(ii) recorded in all subareas but were more frequent in Subarea 48.1 (blackfin icefish – *Chaenocephalus aceratus, Chiodraco hamatus, Chionodraco rastrospinosus, Cryodraco antarcticus* and Antarctic silverfish – *Pleurogramma antarctica*), or

(iii) recorded in all subareas but were more frequent in Subarea 48.3 (mackerel icefish – *Champsocephalus gunanri* and *L. larseni*).

20. The length-frequency distribution of all taxa for which >200 fish have been measured had a modal size class of ≤10 cm, although many species show multi-model (age structured) length-frequencies.

## Incidental mortality of seabirds and marine mammals

21. In 2018, there were two seabird mortalities reported from the krill fishery, one snow petrel (*Pagodroma nivea*) in Subarea 48.1 and one cape petrel (*Daption capense*) in Subarea 48.2. There were also 19 reported mortalities of Antarctic fur seal (*Arctocephalus gazella*) in the fishery in Subarea 48.3, of which 18 were reported from the same vessel.

### Incidental mortality of fur seals in the krill fishery

22. 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 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).

23. 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).

24. 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 an SED and that observers should be required on krill trawl vessels 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).

25. 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.

26. There were no seal mortalities reported between 2008 and 2014, however, there were three mortalities of Antarctic fur seals in 2015 and 2016, none in 2017 and 19 in 2018.

## Estimation of krill green weight

27. 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.

28. In 2011, the Scientific Committee noted that 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 and made a reporting requirement during fishing activities.

## CCAMLR's approach to managing the krill fishery

29. 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).

30. 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 coefficient of variation (CV) of 12.8% and a fraction of the population referred to as $\gamma$ (gamma) estimated using the generalised yield model (GYM) of 0.093.

31. 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 9). 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).

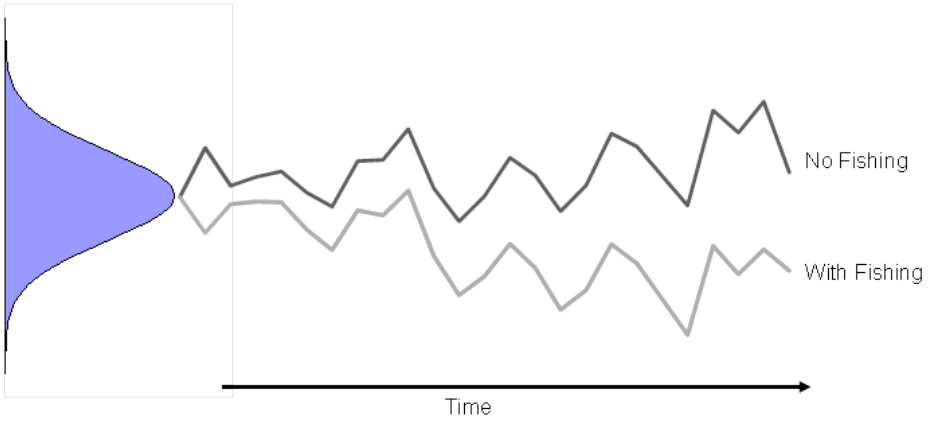



Figure 9: Schematic of krill population projection.

32. The actual catch limit for krill is set on the basis of a sustainable yield ($\gamma$) 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, $\gamma_1$, 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, $\gamma_2$, 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 $\gamma_1$ and $\gamma_2$ 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 10).

33. 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 (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 11). 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).

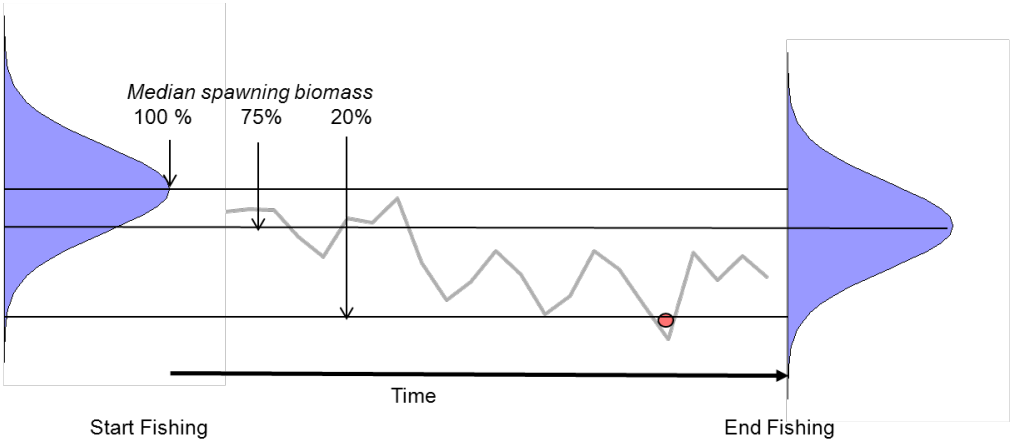



Figure 10: Schematic of krill population projection showing the decision rule information.

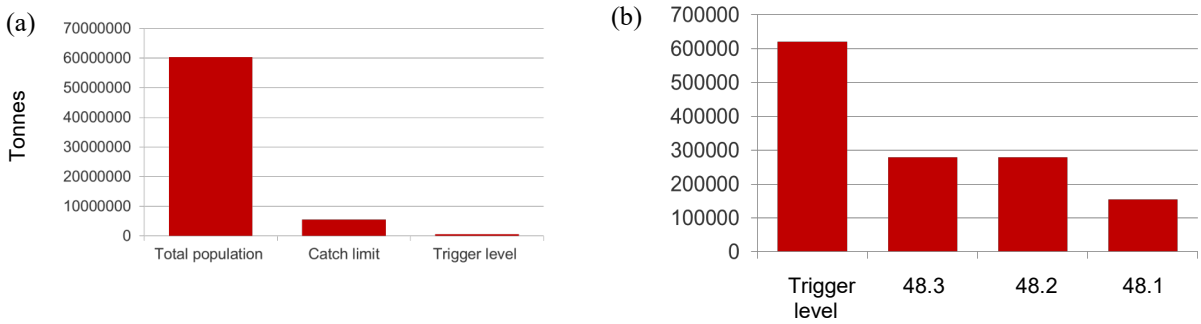



Figure 1: Schematic of (a) the total population size of krill and associated catch limit and trigger level in Area 48, and (b) and the trigger levels in Subareas 48.1, 48.2 and 48.3.

34. 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 ($\gamma_1$) 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

35. The limits on the fishery for krill in Area 48 are summarised in Table 4. The same provisions apply for the fishery for krill in Divisions 58.4.1 and 58.4.2, with the exception of the catch limits that are specified in CMs 51-02 and 51-03.

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 2019.

| 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<br>Haul-by-haul catch and effort data<br>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

36. 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, 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 marine living 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 2019

37. Members intending to participate in established fisheries for krill in 2019 (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 2018. The procedures for krill fishery notification submissions are described in CM 21-03. For 2019, five Members notified their intention to fish for krill with a total of 12 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 2019/20 by subarea/division.

| Vessel name | Member | Subarea/division | | | | | |
|---|---|---|---|---|---|---|---|
| | | 48.3 | 48.2 | 48.1 | 48.4 | 58.4.1 | 58.4.2 |
| *Cabo de Hornos* | Chile | N | N | N | | | |
| *Antarctic Endeavour* | Chile | N | N | N | | | |
| *Fu Rong Hai* | China | N | N | N | N | N | N |
| *Long Teng* | China | N | N | N | N | N | N |
| *Kai Fu Hao* | China | N | N | N | N | | |
| *Kwang Ja Ho* | Korea | N | N | | | | |
| *Insung Ho* | Korea | N | N | N | | | |
| *Sejong* | Korea | N | N | N | | | |
| *Antarctic Endurance* | Norway | N | N | N | N | | |
| *Antarctic Sea* | Norway | N | N | N | N | | |
| *Saga Sea* | Norway | N | N | N | N | | |
| *More Sodruzhestva* | Ukraine | N | N | N | | | |
| Total Members | | 5 | 5 | 5 | 2 | 1 | 1 |
| Total Vessels | | 12 | 12 | 11 | 6 | 2 | 2 |

## References


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

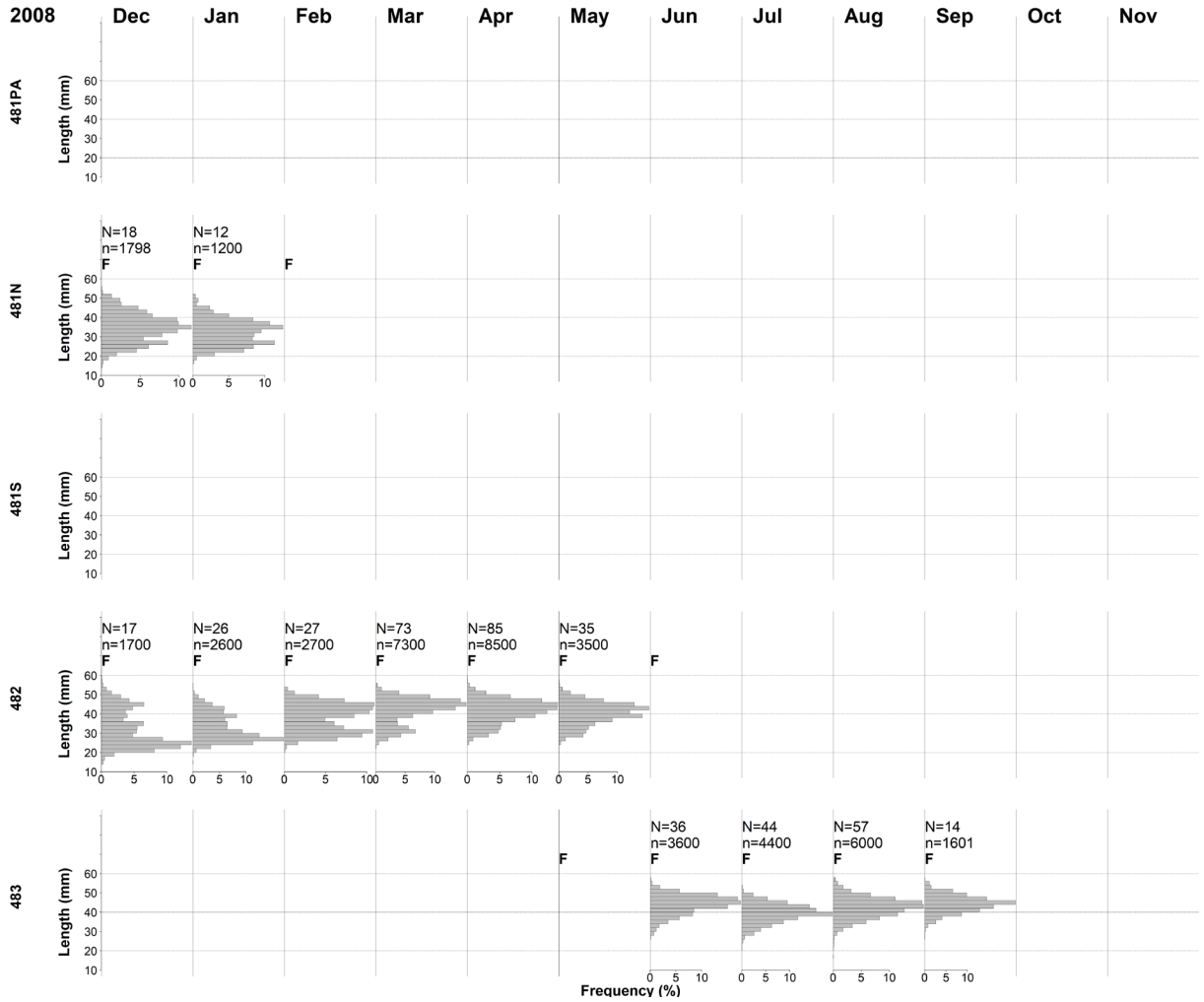



Figure A1.1: Monthly length-frequencies for krill in Subareas 48.1 (PA, N and S), 48.2 and 48.3 in 2008. The number of hauls from which krill were measured (N) and the number of individuals measured (n) in each month are provided; the months in which fishing occurred in a subarea are indicated by the letter F.

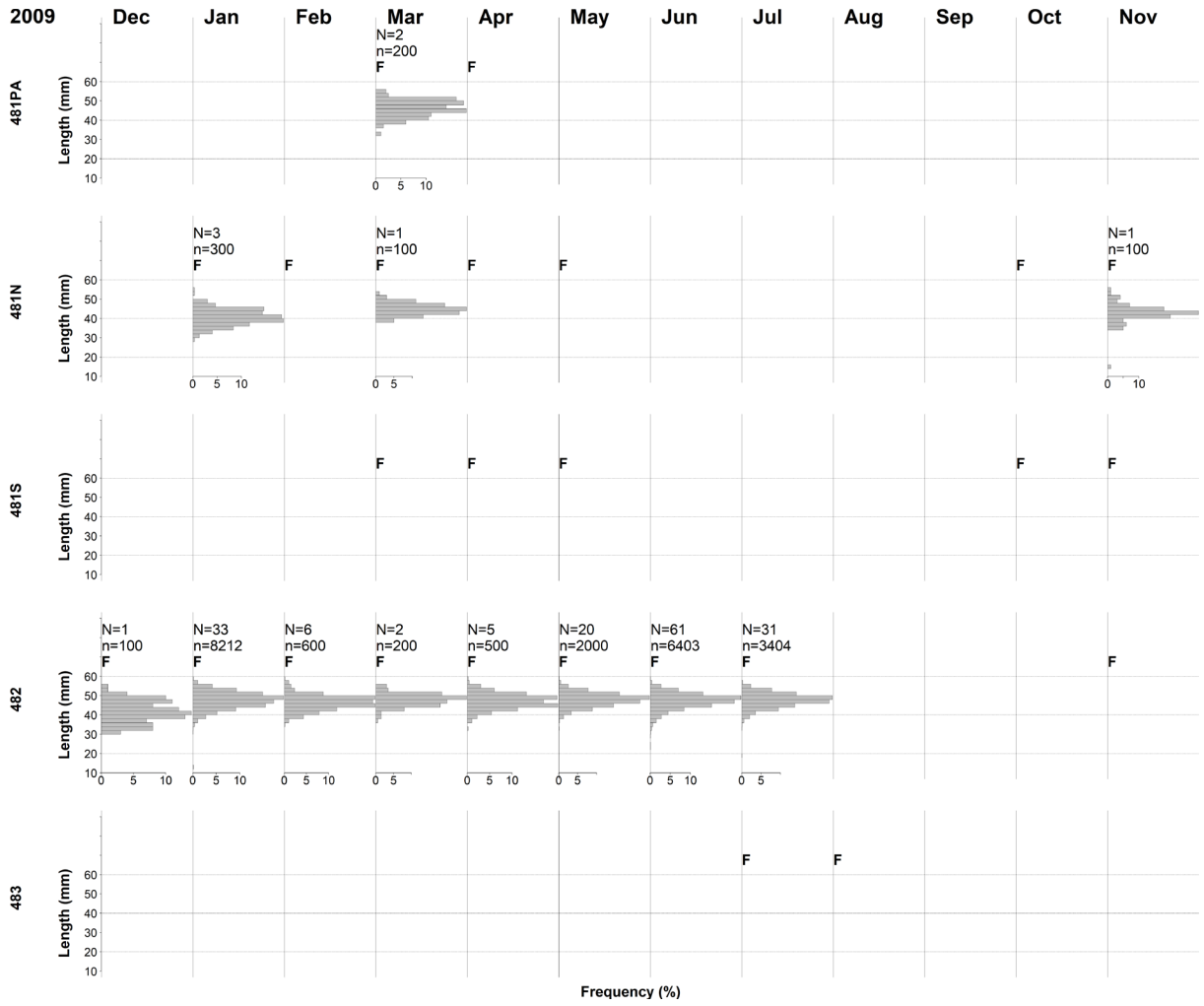



Figure A1.2: Monthly length-frequencies for krill in Subareas 48.1 (PA, N and S), 48.2 and 48.3 in 2009. The number of hauls from which krill were measured (N) and the number of individuals measured (n) in each month are provided; the months in which fishing occurred in a subarea are indicated by the letter F.

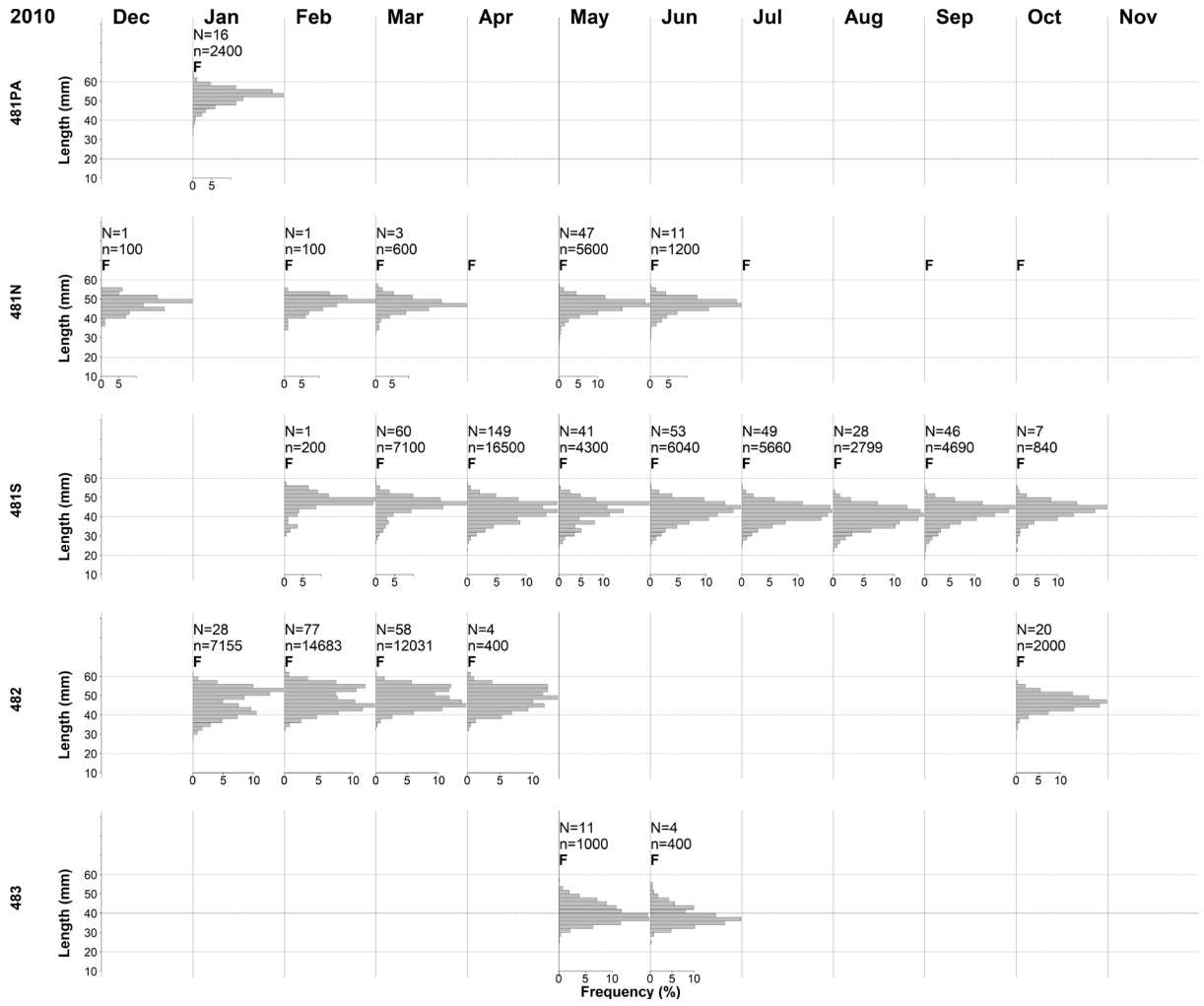



Figure A1.3: Monthly length-frequencies for krill in Subareas 48.1 (PA, N and S), 48.2 and 48.3 in 2010. The number of hauls from which krill were measured (N) and the number of individuals measured (n) in each month are provided; the months in which fishing occurred in a subarea are indicated by the letter F.

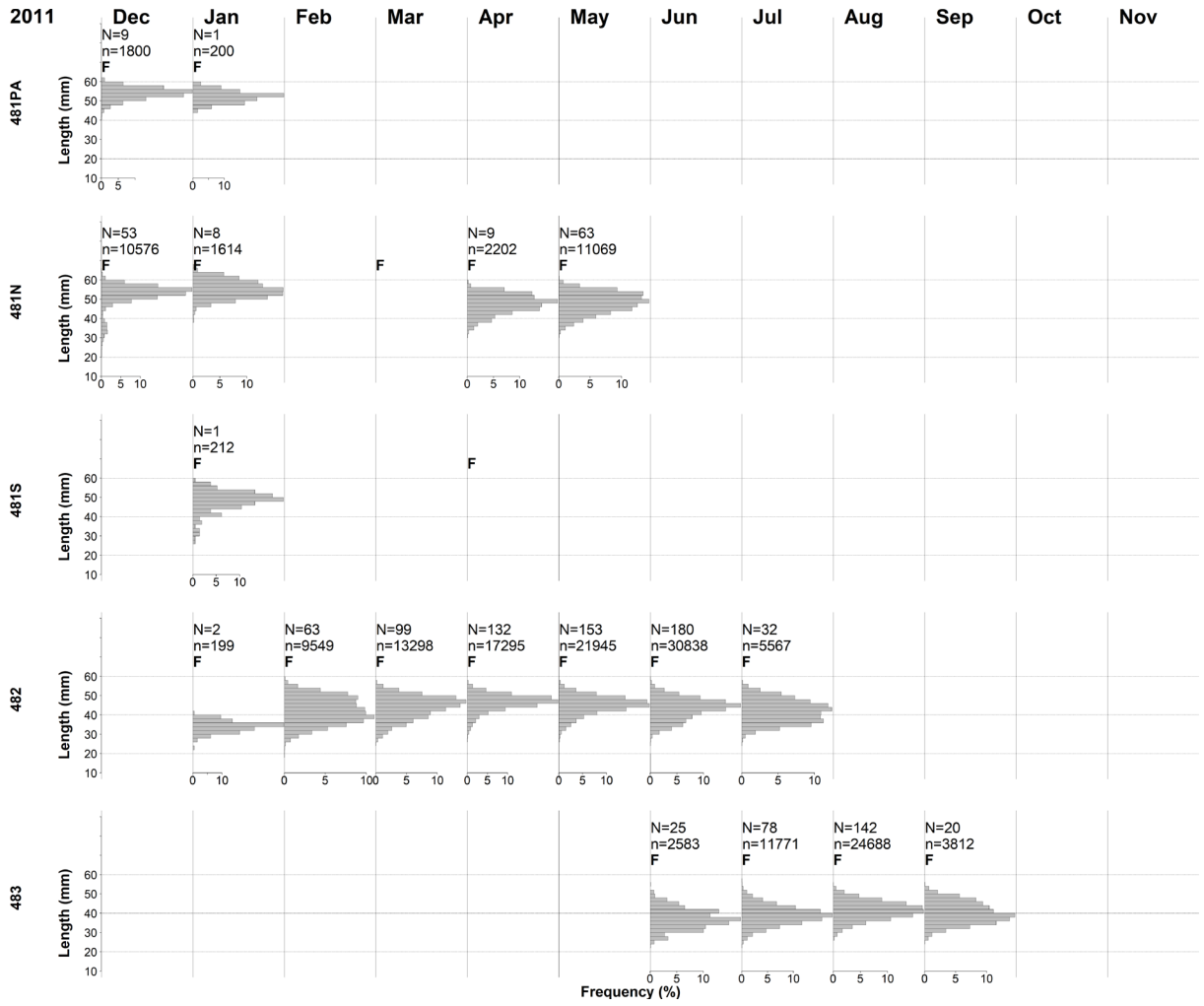



Figure A1.4: Monthly length-frequencies for krill in Subareas 48.1 (PA, N and S), 48.2 and 48.3 in 2011. The number of hauls from which krill were measured (N) and the number of individuals measured (n) in each month are provided; the months in which fishing occurred in a subarea are indicated by the letter F.

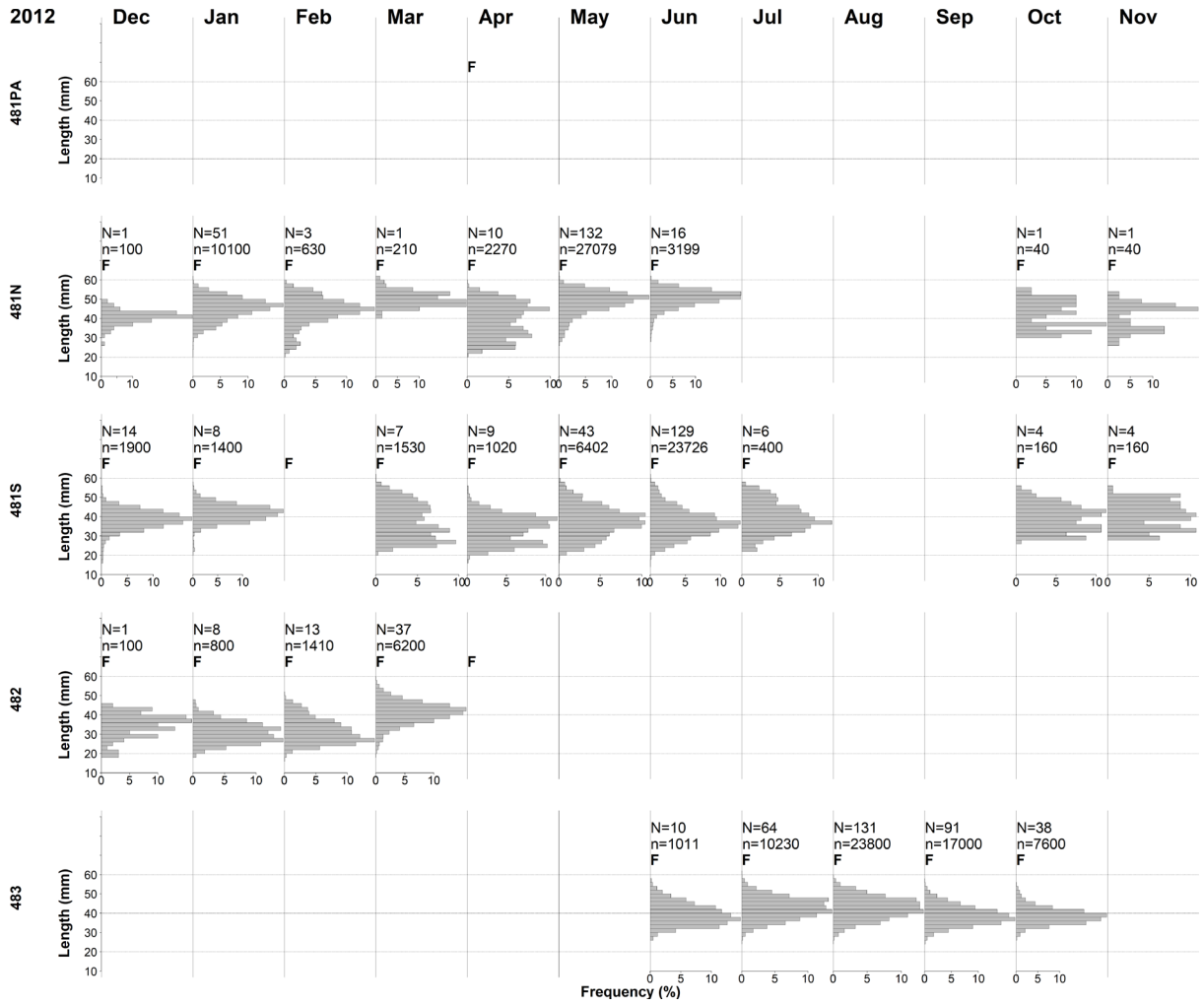



Figure A1.5: Monthly length-frequencies for krill in Subareas 48.1 (PA, N and S), 48.2 and 48.3 in 2012. The number of hauls from which krill were measured (N) and the number of individuals measured (n) in each month are provided; the months in which fishing occurred in a subarea are indicated by the letter F.

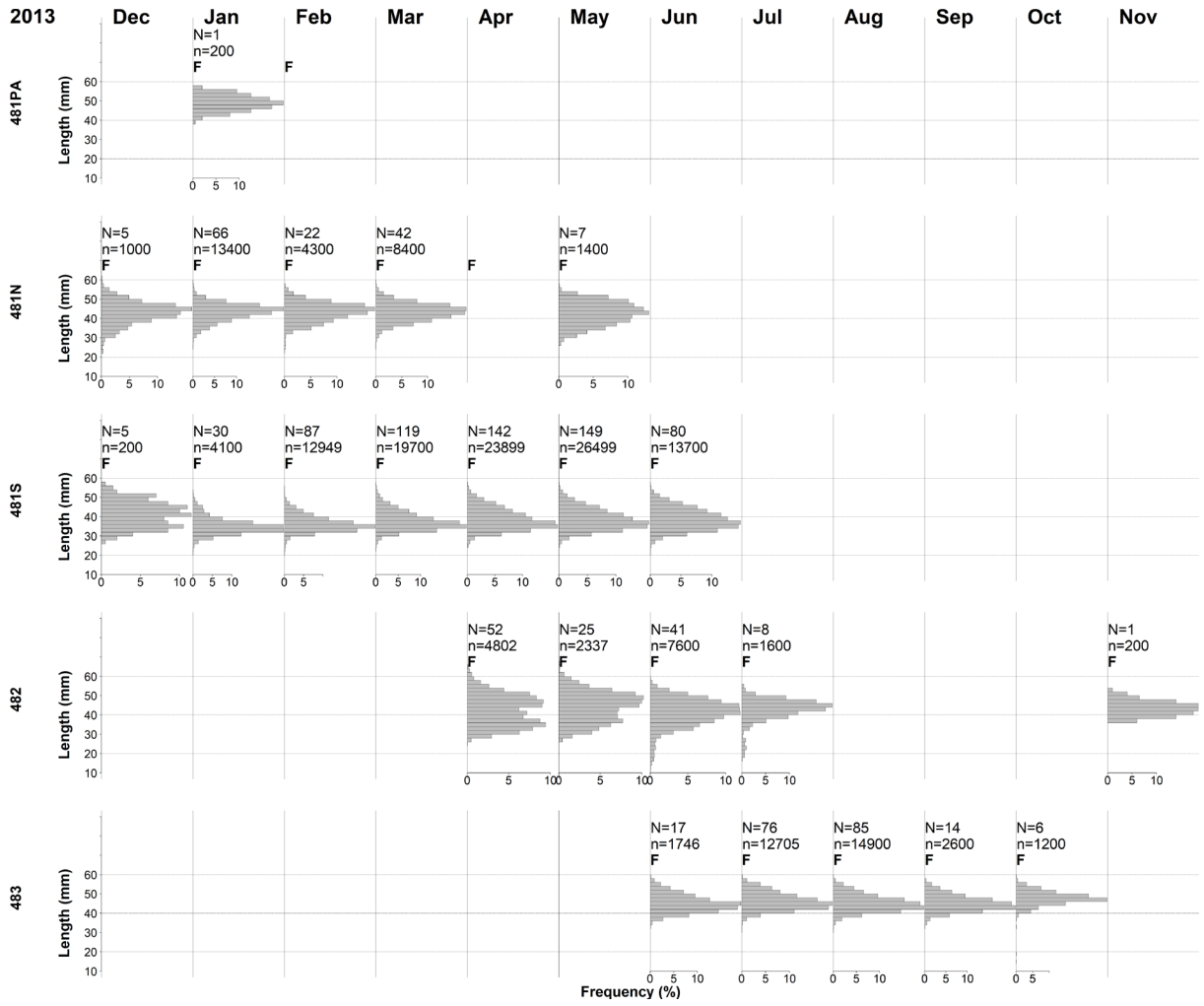



Figure A1.6: Monthly length-frequencies for krill in Subareas 48.1 (PA, N and S), 48.2 and 48.3 in 2013. The number of hauls from which krill were measured (N) and the number of individuals measured (n) in each month are provided; the months in which fishing occurred in a subarea are indicated by the letter F.

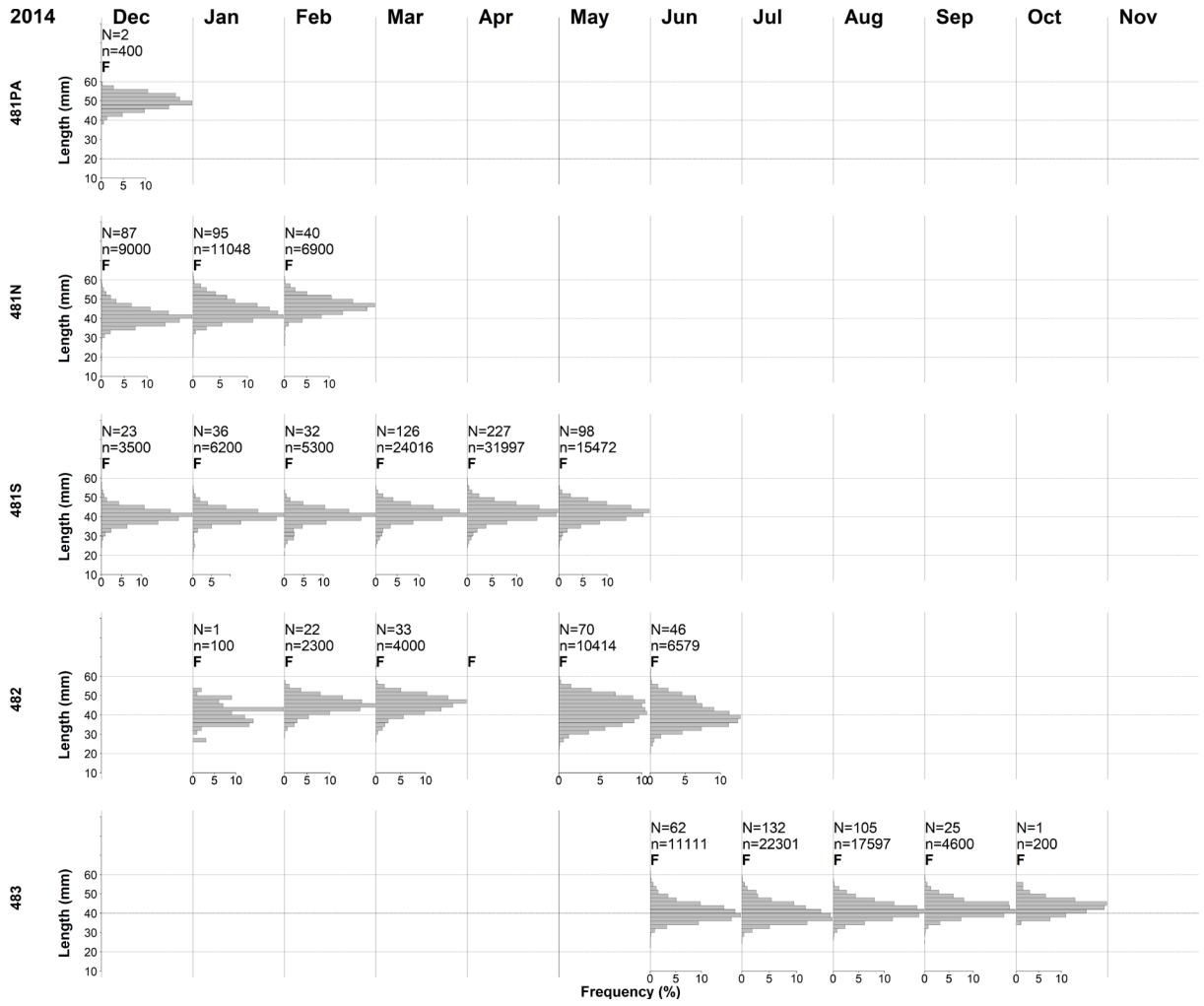



Figure A1.7: Monthly length-frequencies for krill in Subareas 48.1 (PA, N and S), 48.2 and 48.3 in 2014. The number of hauls from which krill were measured (N) and the number of individuals measured (n) in each month are provided; the months in which fishing occurred in a subarea are indicated by the letter F.

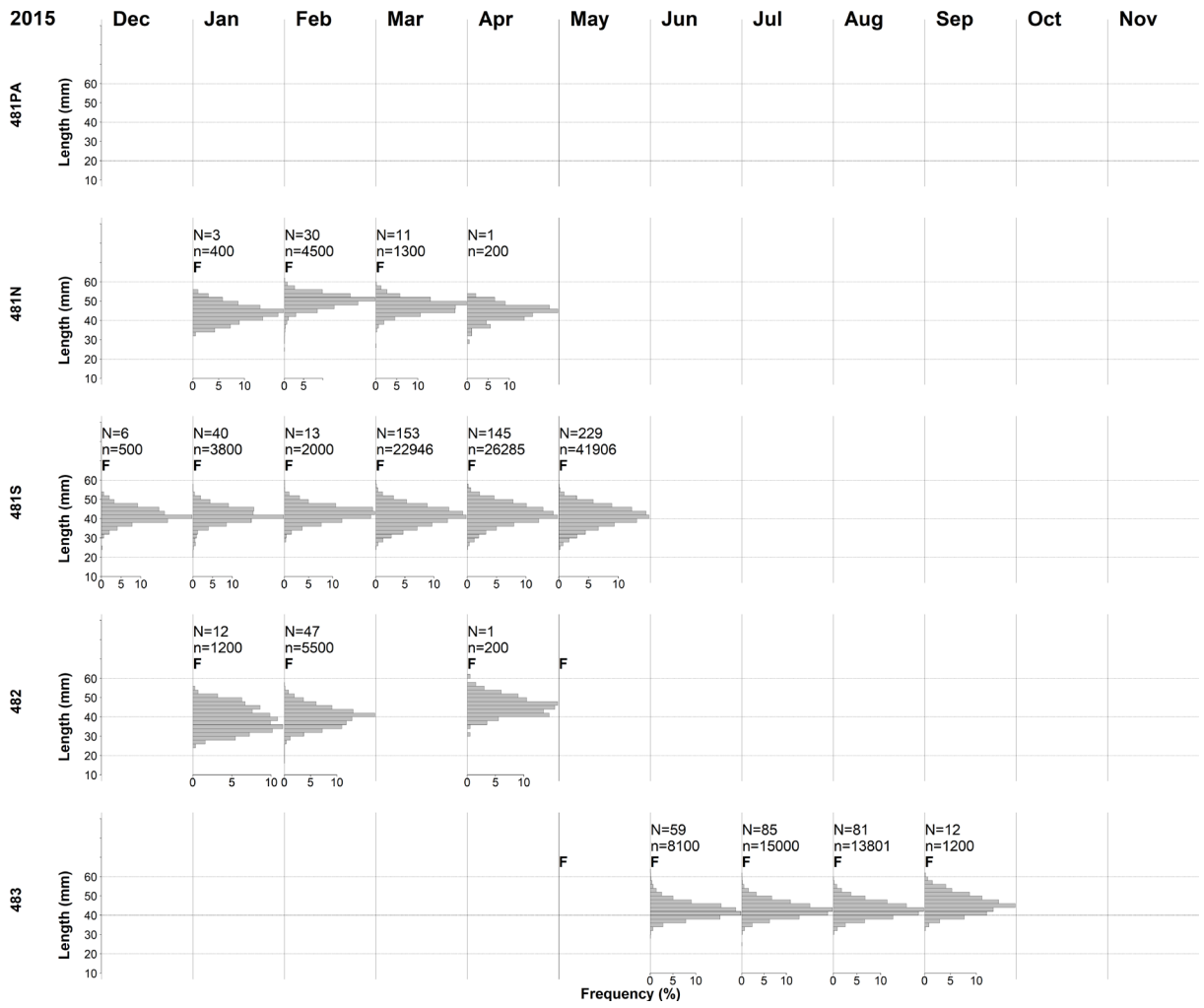



Figure A1.8: Monthly length-frequencies for krill in Subareas 48.1 (N and S), 48.2 and 48.3 in 2015. The number of hauls from which krill were measured (N) and the number of individuals measured (n) in each month are provided; the months in which fishing occurred in a subarea are indicated by the letter F.

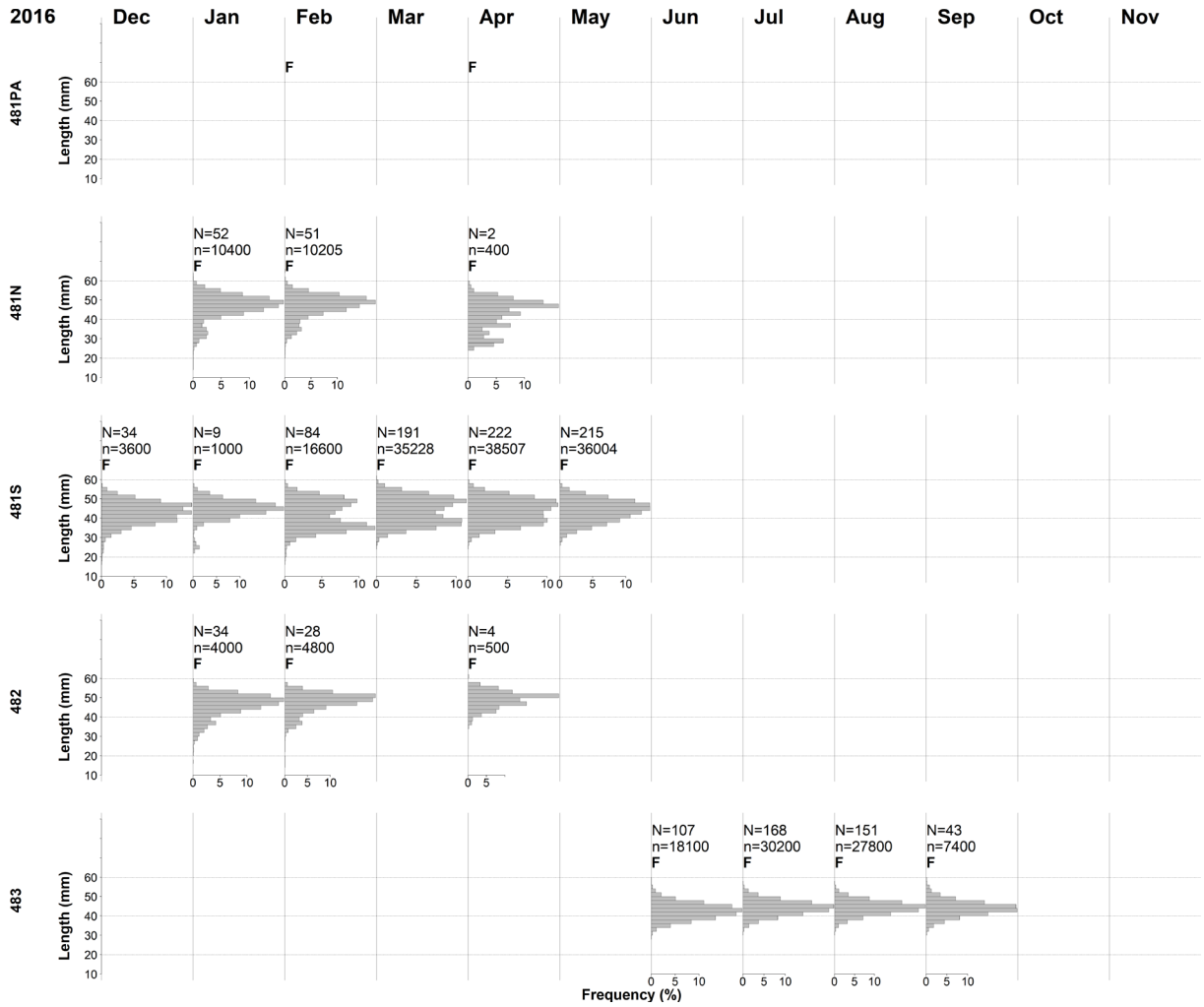



Figure A1.9: Monthly length-frequencies for krill in Subareas 48.1 (PA, N and S), 48.2 and 48.3 in 2016. The number of hauls from which krill were measured (N) and the number of individuals measured (n) in each month are provided; the months in which fishing occurred in a subarea are indicated by the letter F.

Appendix 2

## 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.

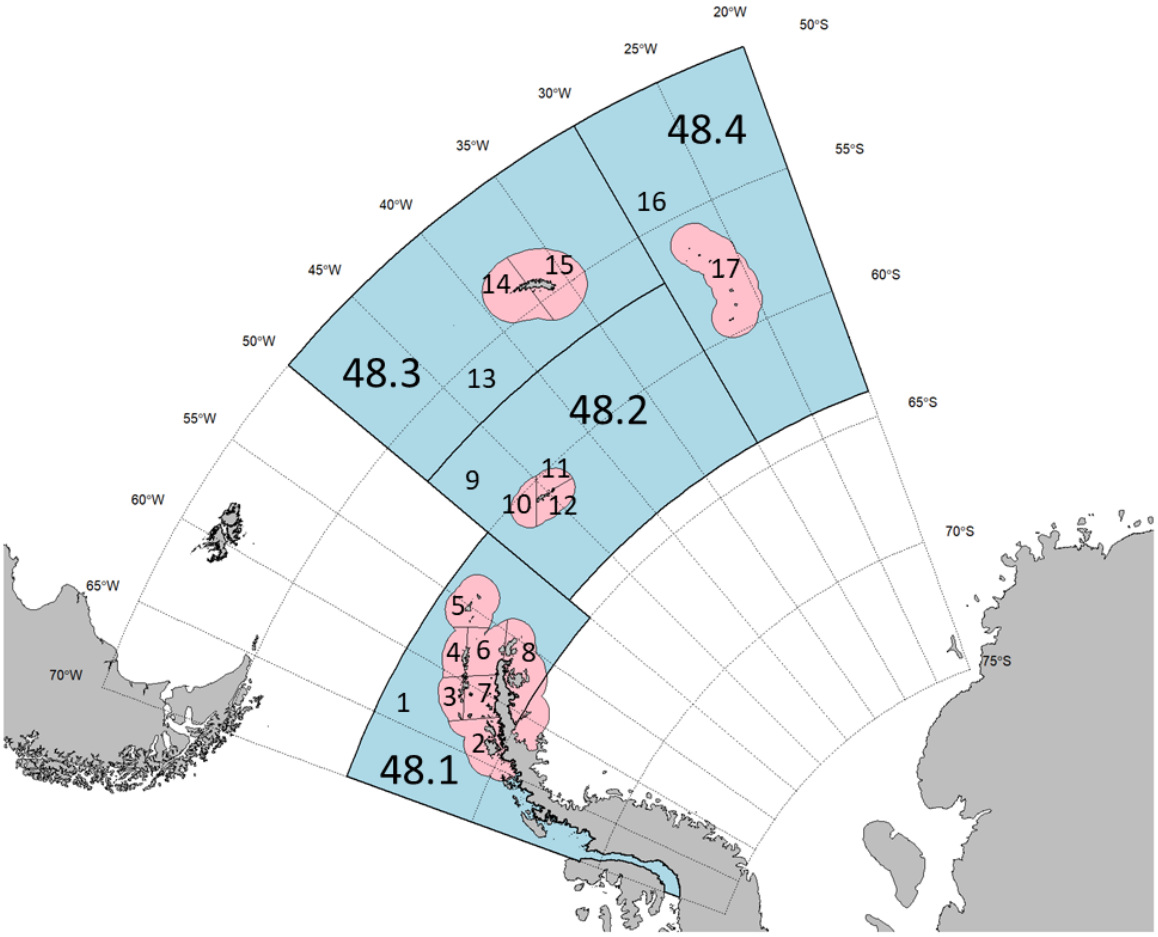



Figure A2.1: Small-scale management units (SSMUs) for the krill fishery in Subarea 48.1, 48.2, 48.3 and 48.4.: 1. Antarctic Peninsula Pelagic Area (APPA), 2. Antarctic Peninsula West (APW), 3. Antarctic Peninsula Drake Passage West (APDPW), 4. Antarctic Peninsula Drake Passage East (APDPE), 5. Antarctic Peninsula Elephant Island (APEI), 6. Antarctic Peninsula Bransfield Strait West (APBSW), 7. Antarctic Peninsula Bransfield Strait East (APBSE), 8. Antarctic Peninsula East (APE), 9. South Orkney Pelagic Area (SOPA), 10. South Orkney West (SOW), 11. South Orkney Northeast (SONE), 12. South Orkney Southeast (SOSE), 13. South Georgia Pelagic Area (SGPA), 14. South Georgia West (SGW), 15. South Georgia East (SGE), 16. South Sandwich Pelagic Area (SSPA), 17. South Sandwich Islands (SSI).

Table A2.1: Annual catch (tonnes) of krill from small-scale management units (SSMUs) in Area 48 reported since 1994. Greater that 95% of catches can be allocated to SSMUs based on haul by haul location reporting. A blank cell indicates that there was no fishing, a 0 indicates that fishing occurred but that there was a catch of < 0.5 tonnes.

| Season | SSMU (Subarea 48.1) | | | | | | | | SSMU (Subarea 48.2) | | | SSMU (Subarea 48.3) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | APPA | APW | APDPW | APDPE | APEI | APBSW | APBSE | APE | SOPA | SOW | SONE | SOSE | SGPA | SGW | SGE |
| 1994 | 5 | 4 | 24849 | 527 | 15736 | 146 | | | 4 | 5807 | 103 | 1115 | 381 | 11 | 11526 |
| 1995 | 3484 | | 13844 | 2646 | 8708 | 388 | | | | 10216 | | | | 142 | 22685 |
| 1996 | 1284 | | 37685 | 4159 | 1350 | 1331 | | 25 | 0 | 0 | 3 | | 15 | 776 | 12139 |
| 1997 | 561 | | 22454 | 13217 | 1022 | 180 | | | | 8 | 91 | | | 74 | 23791 |
| 1998 | 3340 | 2858 | 23888 | 17955 | 5766 | 1594 | | | 259 | 6151 | 304 | | 14 | 3797 | 22722 |
| 1999 | 870 | 3868 | 11382 | 9076 | 8880 | 41 | 804 | | 361 | 44689 | 3429 | 12507 | | | |
| 2000 | 153 | 108 | 31554 | 11012 | 10458 | 6415 | 2936 | | 3148 | 9814 | 1133 | 1496 | 6310 | 1984 | 11052 |
| 2001 | 5 | 683 | 24449 | 18218 | 4609 | 3600 | 759 | | | 1115 | 22 | 3861 | | 10963 | 24768 |
| 2002 | 138 | 3 | 4853 | 1405 | 3914 | 330 | 57 | | 53 | 51086 | 2941 | 893 | 2842 | 8889 | 28180 |
| 2003 | 47 | 58 | 29772 | 1504 | 961 | 336 | 16 | | 547 | 16286 | 59 | 48 | 782 | 13966 | 51411 |
| 2004 | 349 | 248 | 5104 | 1467 | 6172 | 404 | 1900 | | 299 | 47101 | 782 | 10 | 151 | 33171 | 22824 |
| 2005 | 9 | | 5039 | 1966 | 38 | 44 | | | 52 | 70090 | 2033 | 87 | 22 | 308 | 48131 |
| 2006 | | 40 | 41504 | 10133 | 2190 | 13375 | 23326 | | | 2893 | 185 | 33 | | 8236 | 6665 |
| 2007 | 29 | 4 | 12154 | 2079 | 1184 | 502 | 19 | | 10 | 64598 | 3413 | | 6 | 3263 | 17468 |
| 2008 | | | 218 | 113 | 2251 | | | | | 88615 | 178 | 11 | | 35279 | 22352 |
| 2009 | 1500 | | 3327 | 1637 | 3883 | 635 | 20087 | 3049 | 1648 | 89066 | 875 | | | 0 | 0 |
| 2010 | 67 | 5999 | 17290 | 8797 | 1772 | 85514 | 34891 | | 1279 | 48921 | 74 | 218 | | | 8834 |
| 2011 | 392 | 10 | 649 | 7975 | 15 | 59 | 115 | | 490 | 111472 | 3836 | 196 | | 2671 | 53130 |
| 2012 | 11 | 16949 | 20460 | 4901 | 73 | 28422 | 5010 | | 43 | 28789 | 166 | | | 6197 | 50218 |
| 2013 | 83 | 13477 | 3801 | 7725 | 257 | 109155 | 18754 | | 34 | 30539 | 4 | | | 3439 | 28782 |
| 2014 | 113 | 6712 | 19729 | 7374 | 676 | 49589 | 62245 | | | 69962 | 2492 | | | | 75252 |
| 2015 | | 36267 | 347 | 3131 | 5618 | 71007 | 37807 | | 8 | 14282 | 2811 | | | | 54354 |
| 2016 | 13 | 37789 | 10 | 5052 | 625 | 37137 | 73816 | | | 33848 | 436 | 17 | | 218 | 71189 |