



# The use of fishing vessels to provide acoustic data on the distribution and abundance of Antarctic krill and other pelagic species



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## ABSTRACT

A fishery for Antarctic krill (*Euphausia superba*) has existed for over 3 decades and the Commission for Conservation of Antarctic Marine Living Resources (CCAMLR) manages this fishery using precautionary catch limits, fishery data collection and a scientific observer programme operating on the fishing vessels. A recent increase in the number of vessels fishing and the rising costs of undertaking scientific research cruises have focussed attention on being able to use fishing vessels to collect more extensive scientific data sets. In 2011, CCAMLR's Subgroup on Acoustic Survey and Analysis Methods (SG-ASAM) was tasked with assessing the use of acoustic data collected from fishing vessels to provide qualitative and quantitative information on the distribution and relative abundance of Antarctic krill and other pelagic species. SG-ASAM conceived a proof of concept programme and implemented the first stage in 2013 to determine the current setup of acoustic equipment on participating fishing vessels and to establish whether these vessels could collect geo- and time-referenced acoustic data. To date data have been received from 7 krill fishing vessels and SG-ASAM has now focussed on the development of data collection protocols to enable fishing vessels to collect quantitative acoustic data along prescribed transects. While this development work continues, the willingness of fishing industry to participate in such studies has already been demonstrated by several fishing companies, and Norwegian- and Chinese-flagged fishing vessels are undertaking krill biomass surveys in two key fishery Areas in the South Atlantic sector of the Southern Ocean.

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## 1. Introduction

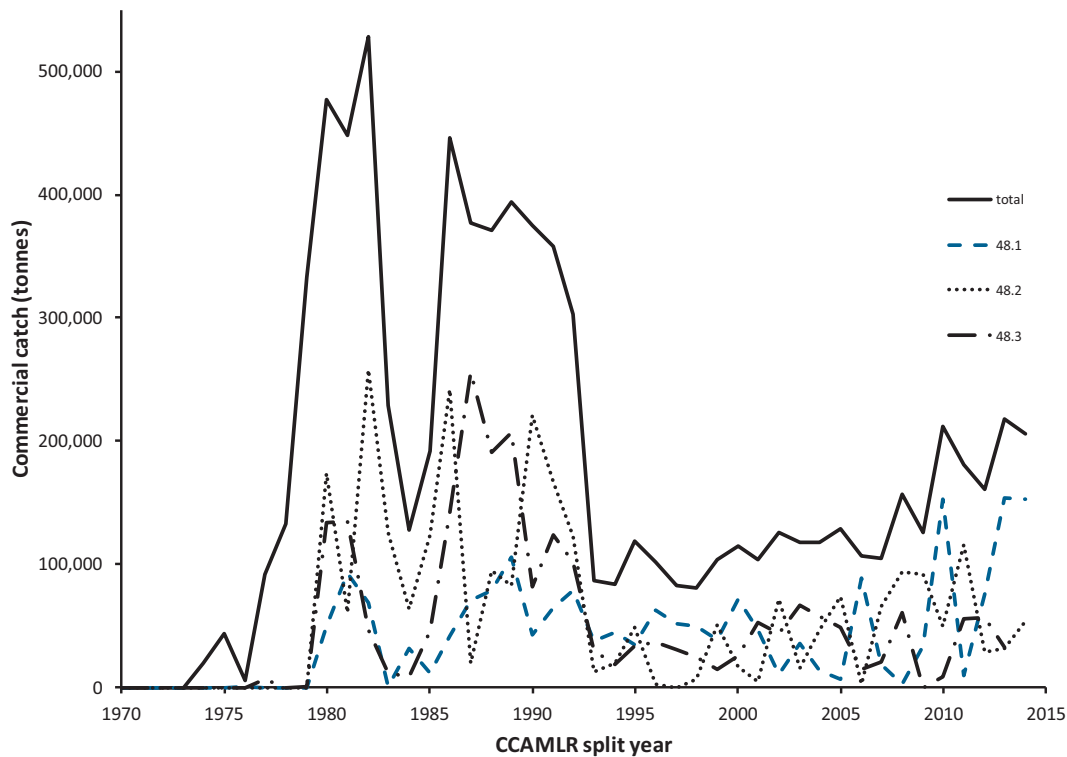
Antarctic krill (*Euphausia superba*) are a key component of the Southern Ocean ecosystem occupying a central role in the pelagic food web as the dominant item in the diet of many predators such as fish, penguins, seals and whales. Since the late 1970s Antarctic krill have also been the target of a directed commercial fishery. Krill catches peaked in the early 1980s with annual catches reaching ~500,000 tonnes, before falling commercial interest in krill and the

dispersing of the former Soviet fishing fleet reduced annual catches to less than ~100,000 tonnes for much of the 1990s. In this present century catches have again increased due to a combination of new products, new countries entering the fishery and new fishing technology. Currently annual krill catches are in the region of 200,000 tonnes and as part of the current fishery management regime, the fishery in Statistical Subarea 48.1 has reached the quota for that region three times since 2010 (Fig. 1).

The krill fishery is managed by the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) which came into being in 1982. CCAMLR manages the krill fishery using ecosystem-based management procedures that take account of the status of both dependent species and the ecosystem as well as the status of the krill stock. Management advice is formulated by CCAMLR's Scientific Committee and associated working groups, agreed by the Commission and enacted through a suite of conservation measures. Data for management of the fishery is obtained from

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**Fig. 1.** Catches of Antarctic krill, *Euphausia superba*. Total catch refers to catch for all fishery Areas in the Southern Ocean (comprising Areas 48 – the Atlantic Ocean sector, Area 58 – the Indian Ocean sector and Area 88 – the Pacific Ocean sector). Catches for Subareas 48.1 (Antarctic Peninsula region), 48.2 (South Orkneys region) and 48.3 (South Georgia region) are also shown. CCAMLR split years represent the fishing season which runs from December to November, such that December 2009–November 2010 is referred to as split year 2010. Catches for 2014 represent catches up until July 2014. Note that fishery in Subarea 48.1 reached the catch limit for that Subarea (155,000 tonnes) in 2010, 2013 and 2014. Data available from <https://www.ccamlr.org/en/document/data/ccamlr-statistical-bulletin-vol-26>.

a variety of sources including catch and effort data from the fishery, information from a scientific observer programme and research data generated by predator monitoring and research cruises run by national science programmes of CCAMLR member countries. For the krill fishery the precautionary catch limit is currently set at ~5.4 million tonnes in the Atlantic region of the Southern Ocean (FAO Statistical Area 48, Subareas 48.1–48.4, Fig. 2). However, until the allocation of this overall limit between smaller management units can be agreed by CCAMLR there is presently a lower total annual limit (the trigger level) of 620,000 tonnes for krill and a proportional allocation between Subareas such that the maximum that can be taken is presently limited in Subarea 48.1–155,000 tonnes, in Subareas 48.2 & 48.3–279,000 tonnes in each, and in Subarea 48.4–93,000 tonnes (CCAMLR conservation measures CM 51-01 and CM 51-07; SC-CAMLR, 2014c).

One of the key parameters used to set the catch limit is an estimate of standing stock of krill ( $B_0$ ). To date, two estimates of  $B_0$  have been obtained; both of these estimates derived from large-scale multi-vessel acoustic surveys across the main distribution centres of krill that coincide with the general location of the krill fishery. The first large-scale survey, FIBEX, took place in 1980 and involved 11 ships (Trathan et al., 1995) while the second, CCAMLR-2000 synoptic survey, took place in 2000 and involved the coordinated use of 4 ships (Watkins et al., 2004). In addition to these two large scale surveys a series of more spatially restricted meso-scale (100 km) surveys are run annually as part of national science programmes undertaken by the UK (Fielding et al., 2014), USA (Reiss et al., 2008) and most recently by Norway (Krafft et al., 2013a). These meso-scale surveys provide information on the status of the ecosystem, for instance on inter-annual variability, but the density estimates are not presently used directly in the determination of precautionary catch limit.

Presently data received from krill fishing vessels relates either to catch/effort data including haul by haul records or to data collected as part of the CCAMLR Scheme of International Scientific Observation where information on catch composition, krill size and maturity data, bycatch and any incidental mortality of seabirds and mammals are recorded.

Over the last few years mounting economic and logistic demands have introduced considerable pressure on research ship-time availability from key national Antarctic research programmes. In particular the number of research vessels able to routinely undertake cruises in support of CCAMLR endorsed monitoring programmes is now substantially smaller than the number of fishing vessels that are operating each season. To locate fishable aggregations of krill, these fishing vessels have to be equipped with acoustic systems that can provide information on relative krill biomass and spatial distribution. In many cases the actual acoustic systems are the same or similar to those used on research vessels to generate quantitative estimates of krill biomass. In addition those fishing vessels are usually present on the fishing grounds for months at a time compared to the much shorter duration of a typical acoustic survey conducted by a research vessel. Therefore, there exists considerable potential to collect data from krill fishing vessels that can be used to improve the management of the krill fishery.

In 2011, recognizing this potential source of information the Scientific Committee of CCAMLR requested that the Subgroup on Acoustic Survey and Analysis Methods (SG-ASAM) should develop advice on how best to collect and evaluate fishing-vessel-based acoustic data on krill and other pelagic species.

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