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The fishery for Antarctic krill – Conflicts between industrial production, protection of biodiversity, and legal governance

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ABSTRACT

The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) is responsible for conserving the Antarctic marine ecosystem, where conservation also includes the management of commercial fisheries. The largest fishery (by weight) in Antarctic waters is that for Antarctic krill, a species vital to biogeochemical cycles and carbon sequestration, and a critical dietary item for a broad guild of marine predators. Fishing interests grew from the 1960s onwards, but catches then declined following the breakup of the Soviet Union. Now catches are again increasing, CCAMLR has been developing a revised krill fishery management framework intended to reduce ecosystem risks to predators at critical times of year. At the CCAMLR meeting in 2024, ongoing development of the revised framework was considered, however no progress was made. Progress is urgent, since part of the existing management approach was not renewed. Consequently, by default, catches in the southwest Atlantic may now aggregate in space and time; the interim catch limit for krill (620,000 t) can now be taken from anywhere and at any time, including at times and in places critical to krill predators, possibly with unintended consequences. Allowing catches to aggregate in space and time is something CCAMLR has long sought to avoid. Existing voluntary measures implemented by the fishery will help distribute catches, but are no substitute for de jure management. In addition to risks to the ecosystem, the current situation also presents risks for fishing nations and for CCAMLR itself. Rapid progress with the revised management framework now depends upon rebuilding consensus.

1. Introduction

The fishery for Antarctic krill (*Euphausia superba*) started in the 1960s, when vessels from the former Soviet Union and Japan began exploratory fishing in East Antarctica [1]. Fishing soon shifted to the southwest Atlantic where krill stocks are more abundant [2]. Catches increased rapidly until the breakup of the Soviet Union, after which they declined. Only in the early 2000s did commercial interests resume. Developments in both fishing technology and new product markets [3] then resulted in a steady increase in catches. In the 2023/24 fishing season (1 December 2023–30 November 2024), reported catches from the southwest Atlantic increased to a record ~ 500,000 t (Fig. 1). Currently, all catches are taken near island archipelagos, from coastal waters that are also important feeding areas for krill-dependent predators (Fig. 2).

Understanding the economic drivers leading to increased krill catches is now important. Only a small percentage of the krill catch is used to develop products for direct human consumption, even though global food security remains an urgent issue (e.g. [4,5]). The majority of catches are used for other goods: krill oil which is incorporated into a range of high value human dietary supplements; aquaculture feed for farmed fish; and pet food for cats and dogs (https://www.qrillpet.com/) (e.g. [3,6]). Exploiting the Antarctic to feed cats and dogs raises important questions, including whether krill fisheries should even be permitted at all.

Antarctic krill is one of the most abundant (multi-cellular) organisms on the planet with the largest circumpolar biomass of any wild free-living species, somewhere in the range of 340–540 Mt, probably greater even than the biomass of humans [7]. The krill stock is one of only a few remaining under-exploited sources of protein left in the world

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ocean [8]; FAO defines a fish population as underfished when its biomass exceeds 120 % of the target level [9]. Bio-acoustic surveys in the southwest Atlantic where the fishery now operates [10,11] suggest that there is a substantial standing stock in that region - about 60.3 Mt. Sustainable catches up to 5.61 Mt were historically thought to be feasible, based on a set of harvest control rules [12,13] the results of which are incorporated into CCAMLR Conservation Measure (CM) 51-01 [14], hereafter CM 51-01. However, such large catches are currently not allowed as further science (e.g. basic ecosystem monitoring; improved understanding of ecological relationships; improved understanding of krill stock identify and stock movement; etc.) is required to ensure that ecosystem impacts from the fishery are minimized, in keeping with Article II of the CAMLR Convention [15]. Further, the harvest control rules have never been empirically tested and need further research, especially in the context of the rapidly recovering populations of baleen whales [16].

Since its inception, CCAMLR has always recognised the potential for ecosystem impacts from fishing [1,17], so has therefore agreed a much lower interim catch limit (the so-called 'trigger' level) of 620,000 t for the southwest Atlantic, also under CM 51-01 [14]. The trigger level was calculated as the sum of the historical maximum catches in FAO Subareas 48.1, 48.2, 48.3 and 48.4 (Fig. 2), prior to 1991 [18, paragraph 3.106]. However, this trigger level has little scientific basis in relation to any assessment of the stock, and is merely a mechanistic approach with little empirical justification [18, paragraph 3.63–3.64]. The trigger level is a fixed interim catch limit across FAO Subareas 48.1, 48.2, 48.3 and 48.4 that has not changed since 1991, even though krill biomass is known to vary spatially and temporally, especially at small spatial scales (e.g. [19–21]).

As the fishery began to increase in the early 2000s, concerns grew that large catches, even up to the trigger level if taken from small areas, must be avoided if predator populations were not to be inadvertently affected by fishing activity. Therefore, to further restrict the fishery, CCAMLR agreed to spatially subdivide the trigger level with a fixed maximum proportion in each Subarea [22], hereafter CM 51-07. The maximum proportions allowed were 25 % (155,000 t) in Subarea 48.1, 45 % (279,000 t) in Subarea 48.2, 45 % (279,000 t) in Subarea 48.3, and 15 % (93,000 t) in Subarea 48.4. Although these Subarea proportions summed to more than 620,000 t, the trigger level provided a strict upper limit for catches in Area 48, whilst allowing flexibility for the fishery. Until 2024, the combination of these two Conservation Measures, CM 51-01 [14] and CM 51-07 [22] provided a highly precautionary catch limit, with spatial distribution of that limit.

With pressure to increase catches (primarily from one or two krill fishing Members), CCAMLR has sought to develop a more robust, science-based management framework. CCAMLR has therefore endorsed [23, paragraph 5.17–5.19] a new work programme to develop a revised framework for managing the krill fishery. This revised framework is intended to specifically account for the needs of different krill predators across both space and time (see [24]) and has been under active development since 2019, including with a pilot analytical project focused on Subarea 48.1 [25–29]. The revised management framework includes the development of three core elements [23, paragraph 5.17–5.19]:

i. A krill stock assessment to estimate precautionary harvest rates;
ii. Regular updates of krill biomass estimates, potentially at multiple scales; and,
iii. A risk assessment framework to inform the spatial allocation of krill catch.

CCAMLR has subsequently recognised that as part of the revised framework, it needs to improve ecosystem monitoring and designate appropriate area-based management tools, including marine protected areas [29]. The revised framework is intended to implement a sustainable ecosystem approach for fisheries management, something that is set out in the principles of the CAMLR Convention [15], and is therefore a legal requirement. A fundamental principle of the CAMLR Convention is that fisheries should not disrupt ecological relationships between harvested, dependent and related populations, and that they must allow for the restoration of depleted populations, something particularly relevant for baleen whales in krill fishery management. Fisheries management must also ensure that the stock sizes of harvested species are maintained and prevent changes that are not reversible; management must also take into account environmental change. Understanding such ecological relationships requires fundamental research and monitoring of the ecosystem, given the complexities of predator-prey and predator-predator relationships that have been identified over the past 60 years (e.g. [16]). To help increase understanding about the ecological impacts of harvesting the CCAMLR Ecosystem Monitoring Program (CEMP) was agreed in the mid-1980s [30], with data collected from 1987 onwards. However, the range of species and monitoring sites has always been limited and is currently under active review. Species currently included are: crabeater seals (*Lobodon carcinophugus*), Antarctic fur seals (*Arctocephulus gazella*), Adélie penguins (*Pygoscelis adeliae*), chinstrap penguins (*P. antarctica*), gentoo penguins (*P. papua*), macaroni penguins (*Eudyptes chrysolophus*), Antarctic petrels (*Fulmaris glaciodes*), cape petrels (*Daption capensis*) and black browed albatross (*Thalassarche melanophris*) [31]. Minke whales (*Balaenoptera acutorostrata*) were originally included, but dropped in 1991 because no suggestions had been forthcoming about appropriate monitoring methods [30].

The revised krill fishery management framework is best viewed as a transition towards a future (undefined) management system that might use ecological indices representing important ecosystem components, that could then be used to alter fishing pressure within a feedback system. Essentially, fishing pressure might be increased or decreased in response to a key set of ecological indicators. Though CCAMLR considered how to implement such a feedback system over a number of years, it has not yet been implemented. Developing such a feedback management system requires identification of appropriate ecosystem variables, together with a sophisticated modelling framework and

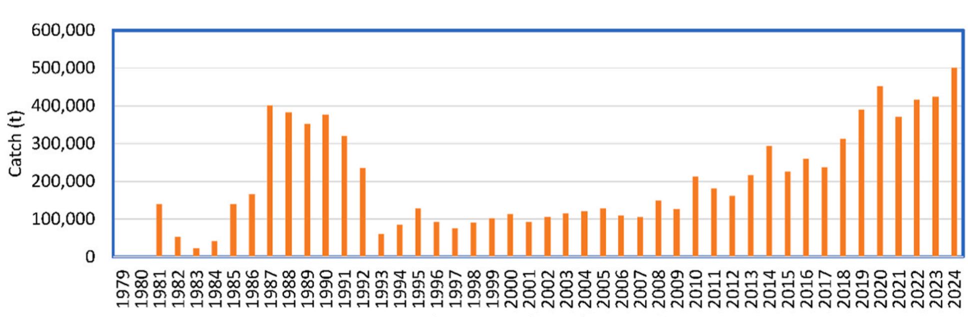

Fig. 1. Annual catches of Antarctic krill reported to CCAMLR for the southwest Atlantic (FAO Area 48).

management evaluation strategy. It would require that all indices and models be subject to rigorous testing to prove that they were robust. Despite considerable effort, CCAMLR has not yet agreed to such an experiment, even though dynamic management is potentially most suitable for pelagic systems (e.g. [32,33]). Currently, such a feedback management system remains aspirational.

At the CCAMLR meeting in 2024 [34], tensions between those CCAMLR Members wanting to increase krill catch limits, and those Members wanting to ensure a careful transition from the existing highly precautionary management system to the revised management framework ultimately led to the expiry of CM 51-07 [22] without any agreement to renew it or develop an alternative measure. This has been perceived as a retrograde management step (e.g. [35]), which will likely have implications for the ecosystem, as well as major ramifications for CCAMLR's decision making. There are likely to be important consequences for both fishing nations, as well as for CCAMLR itself.

2. Methods

Here we consider CCAMLR's transition from the previously highly precautionary management approach, to the revised krill fishery management framework. We build upon previous work [26–29,36], with a focus upon:

i. The need to better understand changing ecological relationships;
ii. The need for a smooth transition to implement the revised management framework;
iii. Consequences, opportunities and risks, including for fishing nations, and;
iv. The future of CCAMLR itself.

We base our assessment upon the peer-reviewed scientific literature, and the publicly available reports from CCAMLR and its Scientific Committee.

3. The need to better understand changing ecological relationships

The CAMLR Convention requires that any harvesting, or associated activities, must be conducted in such a manner that they adhere to a set of restrictive ecological principles [15]. To implement this, CCAMLR requires an understanding of past, present and future ecological states. This is a critical component of the CAMLR Convention, yet detailed scientific understanding about many ecological relationships remains limited. Previous work [16,29,36] and references therein, has identified key processes and associated trophic dependencies that are poorly understood, in particular those associated with the recovery of baleen whales. Such relationships are important, given that CCAMLR was founded upon concerns related to the historical over-exploitation of baleen whales [1]. As krill consumers, recovering populations of baleen whales are in direct competition for krill, whether it be with other predators such as chinstrap penguins (e.g. [37]) that are now in decline [38] as whales recover, or with commercial fisheries. Consequently, regular, spatially explicit, population estimates for baleen whales will now be vital for CCAMLR's future management framework, if krill fisheries are not to adversely impact upon the Antarctic marine ecosystem. Critically, the ongoing recovery of baleen whale populations necessitates that CCAMLR must include them as part of its ecosystem approach to fisheries management. This requires that CCAMLR better understand resource competition between whales, other predators, and the fishery, something that is only just beginning (e.g. [39,40]). Allowing an adequate escapement of krill for recovering populations of

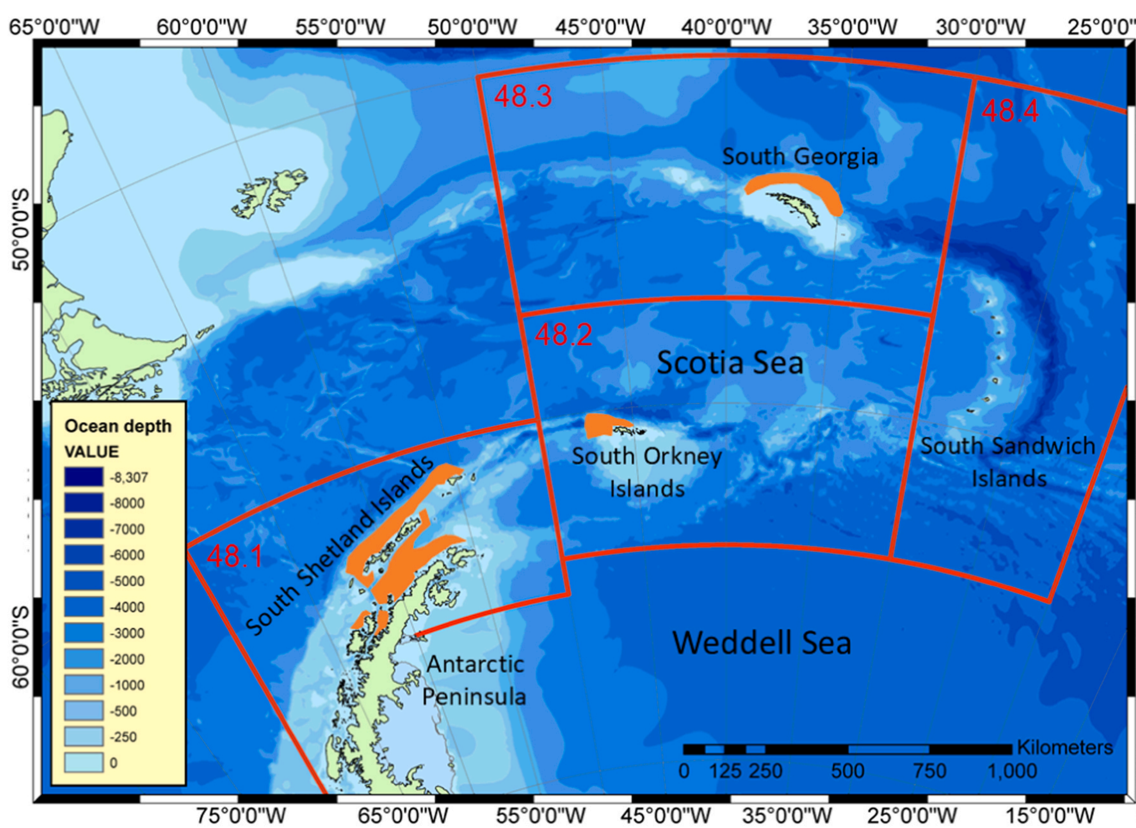

Fig. 2. Cartoon representation of where catches (orange polygons) are taken within the southwest Atlantic, predominantly from coastal waters to the north of the Antarctic Peninsula and South Shetland Islands (FAO Subarea 48.1), northwest of the South Orkney Islands (FAO Subarea 48.2) and north of South Georgia (FAO Subarea 48.3); the polygons represent those areas most intensively fished until 2018, prior to when the voluntary buffers were introduced in Subarea 48.1 [69]. The polygons are redrawn from previous studies [8,20,76].

baleen whales still remains fundamental to the whole premise of the CCAMLR Convention [1,16,17].

In addition to resource competition for krill (with possible associated disturbance to the prey-field aggregation state) which may lead to energetic impacts with population level consequences, there are other threats to individual baleen whales that are also of concern. Importantly, these include, *inter alia*, death (e.g. from whale ship strike, by-catch, or entanglement), and physiological impacts (e.g. pollution, whether chemical, marine debris (including plastic), or noise) (see detailed consideration in [16] and references therein). Mitigating each of these threats may require different management actions. However, these threats may be relatively straightforward to quantify and mitigate compared with those related to population level resource competition. Importantly, however, CCAMLR can only regulate the activities of vessels associated with harvesting, similar threats from other vessels would have to be managed under the Antarctic Treaty or its Environmental Protocol.

The effects of regional climate change on the Antarctic marine ecosystem will also have profound impacts on trophic interactions, together with likely impacts upon krill and krill predators (e.g. [41–48]). However, disentangling any climate change relationships from other drivers of change, is fraught with difficulty, especially in the absence of suitable long-term data for many key species [49,50], for example data on, *inter alia*, population status, recruitment, environmental correlates and prey availability. Any ecological relationships involving krill and recovering populations of baleen whales (e.g. [51–55]) are unlikely to be simple, and some drivers of change may even combine and act in concert [56].

Recognising that ongoing change in the Antarctic marine ecosystem may result in different plausible future states, requires that krill fishery management approaches must be robust to different possibilities; there is the potential for altered habitats, species abundance and distribution, and new trophic interactions. CCAMLR needs to begin planning as soon as possible so it can better understand alternative future ecological states. However, few Members have the resource capacity to undertake the necessary research and monitoring across the area currently fished, hence international collaboration will be key [29], including contributions from philanthropic sources. To provide the necessary infrastructure will require that CCAMLR now develop a long-term data collection and research plan as a matter of urgency. The collection of robust evidence on trophic interactions so that future ecosystem trajectories can be determined will be critical (cf [57]). Without such data, CCAMLR must ensure fishery removals remain precautionary.

With the expiry of CM 51-07 [22], catches up to the trigger level can now feasibly be taken from anywhere, including within small areas, something CCAMLR has previously sought to avoid. Krill trawlers have traditionally exhibited seasonal patterns of movement [58]; however, in the context of reducing sea ice extent [59], and in the absence of CM 51-07 [22], catch aggregation may be facilitated, so that fishery impacts might intensify. Without adequate ecosystem monitoring [29], damage to the ecosystem as a consequence of intense fishing may then go unreported. Importantly, since ecological connectivity is vital to marine ecosystems and species [39], factors influencing populations in one area may have implications elsewhere. For those species that seasonally migrate [60], impacts that occur in areas managed by CCAMLR could also result in repercussions outside the CAMLR Convention Area. Thus, the consequences of CCAMLR being unable to resolve different perspectives on precautionary fisheries management may have wider geographic consequences.

4. The need for a smooth transition to implement the revised management framework

At the annual meeting in 2024, CCAMLR was not able to agree: (i) how to proceed with development of the revised krill fishery management framework, or (ii) how to incorporate spatial management to protect particularly vulnerable parts of the ecosystem [34]. The revised management framework accounts for different predator needs, but areas of important biodiversity (e.g. [61,62]) still need to be agreed by all Members, and then protected. Vital work to identify appropriate monitoring indices [16,29] is missing, especially those related to baleen whales (e.g. [63]). Monitoring for penguins, undertaken by National Antarctic Research Programmes and by Oceanites Inc., a USA not-for-profit organisation (https://www.oceanites.org/research-portal/state-of-antarctic-penguins-reports), is rapidly improving, but monitoring for baleen whales remains totally inadequate [16]. Monitoring data from CEMP have never been fully incorporated into CCAMLR's management approach, even though this was something CCAMLR aspired to when originally formulating CEMP (see [16]). Indeed, in 2003 CCAMLR recognised that it was unlikely that CEMP would be able to distinguish between ecosystem changes due to harvesting and changes due to environmental variability, whether physical or biological, and that CEMP may never be able to distinguish between these different and potentially confounding causal factors at then current harvesting levels [64, paragraph 3.11–3.12]. Consequently, a further review of CEMP is currently underway to ensure that it is more fit for purpose; this should include scientists external to CCAMLR, to ensure that it meets the challenges of a modern ecosystem approach to fisheries management. Also key will be the establishment of a frameworks for access and use of the monitoring data.

The revised krill fishery management framework is intended to extend the existing precautionary approach through the addition of a risk assessment. Having perfect knowledge, CCAMLR could distribute catches in a way that avoids areas of high ecosystem risk, equivalent to using an accurate dynamic ecosystem model for determining a spatially and temporally resolved fishing strategy [24]. However, without such knowledge, CCAMLR can use the risk assessment to guide fishery catch distribution towards areas of lower ecosystem risk. Consequently, this revised framework is an improvement over the current approach in that it requires more detailed information about the needs of predators and their important feeding areas. Fully parameterised spatial and temporal consumption estimates of krill by whales and other krill predators are now key for CCAMLR moving forward with the revised krill fishery management framework.

To transition towards the revised management framework, CCAMLR will need access to new field data collection programmes to better determine the spatial and temporal distribution of krill consumption levels, so that the risk assessment can be parameterised with up-to-date data. The pilot study for Subarea 48.1 facilitates this for the Antarctic Peninsula, but similar work has only just started for other Subareas (e.g. [65]). Such work is vital, if ecosystem impacts are to be avoided as catches increase. In the past CCAMLR has relied upon research and monitoring provided by Members and their National Antarctic Research Programmes, and this situation remains true today. Consequently, any revision of CEMP will still rely upon Member contributions, and any contributions made available by philanthropic entities, including not-for-profit organisations such as Oceanites Inc. In essence, CCAMLR Members have the power to redesign and incorporate CEMP into management, but CCAMLR will still need external support for any implementation of CEMP. This must now happen before catches are allowed to increase.

If the krill risk assessment is not correctly parameterised, including with representative winter data for krill abundance and distribution (see criticisms by [29]), putative management units may inadvertently facilitate catch aggregation such that local exploitation rates increase to unsustainable levels. In particular, the winter period remains data-poor; all existing survey data for krill, land-based predators, and pelagic predators are biased towards the summer. As such, the krill fishery risk assessment might result in poorly designed management units with inappropriate catch allocations. This is particularly important for Subareas 48.1 and 48.3 where the fishery predominantly operates in the autumn and early winter.

With the expiration of CM 51-07 [22], catch levels are most likely to become focussed in Subareas 48.1 and 48.2, as these are the preferred krill fishing grounds in the southwest Atlantic. Importantly, increasing the spatial and temporal distribution of catches within these Subareas will not be successful without a properly parameterized krill fishery risk assessment.

5. Consequences, opportunities and risks

A linear projection for the increase in catches since 2012 suggests that krill catches will reach the interim catch limit (the trigger level) within 6 years. However, with no constraints on where and when catches are allowed, catches may increase more rapidly. The historical allocation of the trigger level for Subarea 48.1 has been reached in most years over the past decade, so catches in that Subarea are likely to increase most rapidly in the absence of CM 51-07 [22], especially given the development of additional new modern vessels with high catch capacity. Moreover, the development of new markets in countries with major aquaculture industries, such as in southern Asia [66], could mean that the fishery now expands very rapidly should markets in those regions switch to krill meal.

At present, CM 51-01 [14] places an absolute limit on krill fishery development, with a maximum catch in the southwest Atlantic of 620, 000 t (the trigger level). This measure has no expiration date; consequently, orderly development of the fishery requires that CM 51-01 [14] is renegotiated. Without a revised trigger level, or replacement catch limit, development of the fishery will stall. This could create further tensions within CCAMLR.

Operators in the fishery must then decide whether to pursue catches elsewhere, most likely in East Antarctica where catch limits have previously been agreed under CM 51-02 [67] and CM 51-03 [68] for two separate areas, or commit to developing revised management in the southwest Atlantic. Either way, the fishery will face new challenges. In East Antarctica the catch limits are based on old data and should be revised.

To facilitate improved management in the southwest Atlantic requires that progress must be made on the spatial and temporal distribution of catches to avoid catch aggregation; progress also requires an effective monitoring framework and the establishment of appropriate spatial protection. Critically, all this requires rebuilding consensus within CCAMLR. Currently, the fishery already voluntarily avoids penguin breeding colonies in the summer [69]. Additional voluntary regulations to stop catches aggregating in other sensitive areas, including for areas important to pelagic predators such as recovering populations of baleen whales, will now be crucial. However, though important, voluntary measure come with risks and economic pressures, and are no substitute for de jure measures agreed through CCAMLR.

With catches already at $\sim$ 500,000 t in the 2023/24 fishing season, and rapidly approaching the trigger level, fishing operatives need to rapidly develop plans to ensure CCAMLR can still function.

6. The future of CCAMLR itself

Over the past 20 years, CCAMLR has experienced a number of challenges, with each leading to prolonged, intense debates that continue to show little sign of resolution. These have primarily revolved around how CCAMLR should manage the conservation, maintenance and restoration of biodiversity in the Antarctic. For example, the debate about the implementation of Marine Protected Areas (MPA; see [70]) has been ongoing for almost two decades; indeed, CCAMLR has only managed to designate two MPAs (e.g. [71,72]), falling well short of its original aspirations. Similarly, CCAMLR has also failed to develop a meaningful climate change response work plan (e.g. [48]), despite well over a decade of debate. Finally, in recent years CCAMLR has also now begun to experience additional challenges, including about how to manage existing fisheries where one Member blocks consensus (e.g. [73]).

The expiration of CM 51-07 [22], probably reflects different aspects of each of these debates; potentially summarised as: How can CCAMLR's ecosystem approach to fisheries management be made robust to a changing ecosystem by integrating spatial management, and the need for adequate data? Even if properly integrated, these elements still point to the need for highly precautionary catch limits.

In the past, CCAMLR has been subject to two Performance Reviews, firstly in 2008 and secondly in 2017. To date, not all of the recommendations from the two Review Panels have been implemented (e.g. [74]), and greater efforts must be made to implement those outstanding recommendations that still remain pertinent. A Third Performance Review should also now take place, providing recommendations to ensure CCAMLR maintains its precautionary approach, more specifically that CCAMLR needs to return to its historical position whereby exploitation does not outrun the scientific evidence available, as previously happened to the detriment of the Antarctic ecosystem. Should conflicts continue to escalate, or prove intractable, real risks to political stability in the Southern Ocean could arise and it would be challenging to make CCAMLR accountable.

Over the past 60 years, the Antarctic Treaty and CCAMLR have both been subject to external geopolitical tensions and internal governance challenges [75]. Nevertheless, as potential threats to the stability of the Antarctic Treaty System arose, the resilience of the System overcame each of the various challenges [75]. Optimistically however, history might repeat itself, and conflicts between fishing nations and conservation-minded nations will be resolved, leaving CCAMLR plausibly stronger, albeit a little different. The alternative whereby conflicts and tensions escalate would leave the Southern Ocean at grave risk of a return to unregulated fishing, something most Members would not wish to countenance.

7. Conclusion and integration

CCAMLR has managed the krill fishery for over 40 years, during which time catches have remained low. However, as pressure to increase catches intensifies, a more-robust science-based management framework becomes ever more vital. A revised management framework is therefore in the interests of all CCAMLR Members. How this is designed and implemented requires consensus.

Not all fishing nations have engaged in ecosystem monitoring, beyond undertaking meso- and large-scale acoustic surveys to determine krill abundance and distribution, and to quantify krill recruitment. Under the 'polluter pays principle', there should be an absolute requirement for fishing nations to contribute to all aspects of ecosystem monitoring, including collection of monitoring data related to penguin population change, and baleen whale population recovery (see [16] and references therein). There is also an absolute requirement for enhanced international collaboration to collect and make available relevant ecosystem data, including through collaboration with the International Whaling Commission. Importantly, there now needs to be the political will from all fishing nations to actively engage in CCAMLR's ecosystem approach to fisheries management.

Consequently, to begin the process of rebuilding trust, we recommend:

a. Rapid action to underpin the revised krill fishery management framework, including an explicit commitment by Members to collect up-to-date monitoring data for krill, baleen whales and other krill predators to help inform the revised management framework. Both summer and winter monitoring data will be needed. Such work must be integrated into CEMP and must include close collaboration with the International Whaling Commission.
b. Identification and agreement on areas requiring the designation of appropriate area-based management tools, including marine protected areas and both temporal and spatial closures. Considerable

effort to identify candidate closure measures has already been undertaken (see proposals identified in [72]), but more needs to be achieved, including provision of detailed objections by fishing Members to these proposed measures.

c. Monitoring data will be vital for ensuring that the fishery is not impacting the marine ecosystem, including negatively impacting the recovery of baleen whale populations. Monitoring data will also be needed to demonstrate the effectiveness of any protected area closures (including both temporal and spatial closures) as required by CM 91-04 [70].
d. Agreement on a staged approach to increase catch limits, once collection of monitoring data has been initiated.
e. Agreement to set aside any areas not currently fished for krill, closing these areas until such time that monitoring data are available, or economic interests indicate the need to revise the closed area status.
f. Agreement to implement international observer coverage on all krill fishing vessels; international scrutiny is now a fundamental requirement for all fisheries.
g. Agreement to review all krill fishery management measures on a regular basis, so that fishery management can respond to new information and improved understanding. Given regional climate change, and the ongoing recovery of baleen whale populations, it is now certain that management must become more adaptable and responsive. CCAMLR has an obligation to become more dynamic in its management approach.

Parallel progress can be made on many of these topics, and it is only the increase in catches which should wait on the development of other parts of the management infrastructure. Many of these topics have been identified and debated within CCAMLR over many years; for example, the staged approach to increase catches was first discussed in 2011 when the Scientific Committee held a symposium on the management of krill harvesting. Progress now requires that CCAMLR develop a plan for how to move forward. Once endorsed by the Commission, the Scientific Committee needs to implement the plan.

With krill fishery management stalled, the impetus to develop consensus lies with all Members of CCAMLR; however, those Members that fish for krill have an especial responsibility to actively engage with those Members seeking to implement more appropriate management for this sensitive marine ecosystem. Without active engagement that leads to consensus, krill catches in the southwest Atlantic will inevitably remain capped at 620,000 t, not much greater than the catch in the 2023/24 fishing season. Catches at this level are well beyond the level that CCAMLR historically considered precautionary under CM 51-07 [22] and should not increase without a robust scientific foundation.

CRediT authorship contribution statement

Ari Friedlaender: Writing – review & editing, Conceptualization. **Trathan Philip N:** Writing – original draft, Visualization, Supervision, Project administration, Investigation, Formal analysis, Conceptualization. **Ryan Reisinger:** Writing – review & editing, Conceptualization. **Chris Johnson:** Writing – review & editing, Conceptualization.

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