

## MARINE CONSERVATION POLICY

# Science-based management in decline in the Southern Ocean

The burden of proof is being turned upside down

By **Cassandra M. Brooks,<sup>1</sup> Larry B. Crowder,<sup>1,2</sup> Lisa M. Curran,<sup>1</sup> Robert B. Dunbar,<sup>1</sup> David G. Ainley,<sup>3</sup> Klaus J. Dodds,<sup>4</sup> Kristina M. Gjerde,<sup>5</sup> U. Rashid Sumaila<sup>6</sup>**

**W**ith an internationally lauded approach to conserving Southern Ocean ecosystems (1), the healthiest marine ecosystems on Earth, the Commission on the Conservation of Antarctic Marine Living Resources (CCAMLR), has committed to adopting marine protected areas (MPAs) in the waters around Antarctica (2). But conflict over MPAs has led CCAMLR member states to disregard the best available science, distort the foundational rules of their convention, break trust, and threaten the integrity of one of the world's most well-regarded science-based multinational governance efforts. With negotiations resuming at the CCAMLR meeting beginning 17 October, we offer recommendations aimed at implementing effective Southern Ocean MPAs, upholding CCAMLR's mandate, and maintaining its global leadership in ecosystem-based management. Given the historic conservation and diplomatic success of CCAMLR and Antarctic governance writ large, if we cannot adopt meaningful MPAs in the Southern Ocean, it does not bode well for doing so in the rest of the high seas.

## EXEMPLARY SCIENCE-BASED MANAGEMENT

Antarctica is exceptional. The coldest, windiest, most pristine, and most remote continent is set aside by the Antarctic Treaty System (ATS) as a global commons dedicated to peace and science (3). The Convention on the Conservation of Antarctic Marine Living Resources (CAMLRL Convention) is the arm of the ATS that governs the use of marine life

in the ocean surrounding the continent (see the figure). Its primary objective is conservation, defined to include "rational use," which permits fishing by CCAMLR's 24 member states (plus the European Union) but only under conservation principles of precautionary, ecosystem-based management (1, 4). All management decisions require consensus, and that management takes full account of the best scientific information available, as determined by CCAMLR's Scientific Committee, an advisory body composed of international scientists (4). Commercial fishing is only permitted in regions where CCAMLR has developed scientifically grounded rules (e.g., total allowable catch) via consensus. Almost half of the CCAMLR area is closed to fishing on a year-to-year basis due to lack of data to support fishing, conservation rules to protect benthos, lack of known fish stocks, extensive ice, or other reasons.

***"The Commission has a critical window of opportunity to uphold its status as a leader in resource management."***

CCAMLR's exemplary management exceeds best practices for regional fisheries management organizations (1). CCAMLR operates by ecological rather than political boundaries in that it manages a discrete ecosystem, the Southern Ocean defined as south of the Antarctic Convergence, as demanded by the scientists who crafted the CAMLR Convention (see the figure). Successes include implementing management for Antarctic krill (*Euphasia superba*) that includes precautionary catch limits and monitoring for effects on krill predators and dramatically reducing illegal, unregulated, and unreported fishing in the Southern Ocean (1, 5).

In 2002, in line with this leadership, CCAMLR committed to designating a network of MPAs in the Southern Ocean (2). MPAs are broadly recognized as invaluable tools to assess, manage, and mitigate negative human effects and maintain biodiversity

(6). CCAMLR scientists identified priority areas for protection (2), and commission states mandated that MPAs be based on the best available science, protect key ecosystem processes, habitats, and biodiversity, and include scientific reference areas to monitor long-term effects of fishing and climate change (7).

The Antarctic is changing rapidly with potential global repercussions for sea-level rise, ocean circulation, and climate regulation. Locally, climate change is driving fluctuations in ice cover, shifts in population distributions, and alterations in primary productivity (8). Declines of ice-dependent Antarctic krill are potentially causing cascades throughout the ecosystem (8). Still, many CCAMLR fishing States advocate for increased catches of krill and toothfish (9). With decreases in ice and krill, fishing vessels are increasingly encroaching upon penguin and whale foraging grounds, compounding climate change stressors (10). To meet rising demands for toothfish (*Dissostichus eleginoides* and *D. mawsoni*) sold as lucrative "Chilean sea bass," fishers have pushed for higher catches and expanding fishing grounds (2, 9). Ecological repercussions of removing toothfish, the region's top fish predator, are unknown (11).

## COMPROMISING PROTECTIONS

Moving toward an MPA network, CCAMLR adopted the world's first high seas MPA near the South Orkney Islands in 2009 (see the figure). Although the stated goal of the MPA is biodiversity conservation, conflicts between

preservation and fishing access produced a compromised result. The modified MPA excluded areas of highest ecological value to avoid conflict with commercial krill fisheries operated by several CCAMLR States (2) (see the figure). Japan, with the endorsement of South Korea and

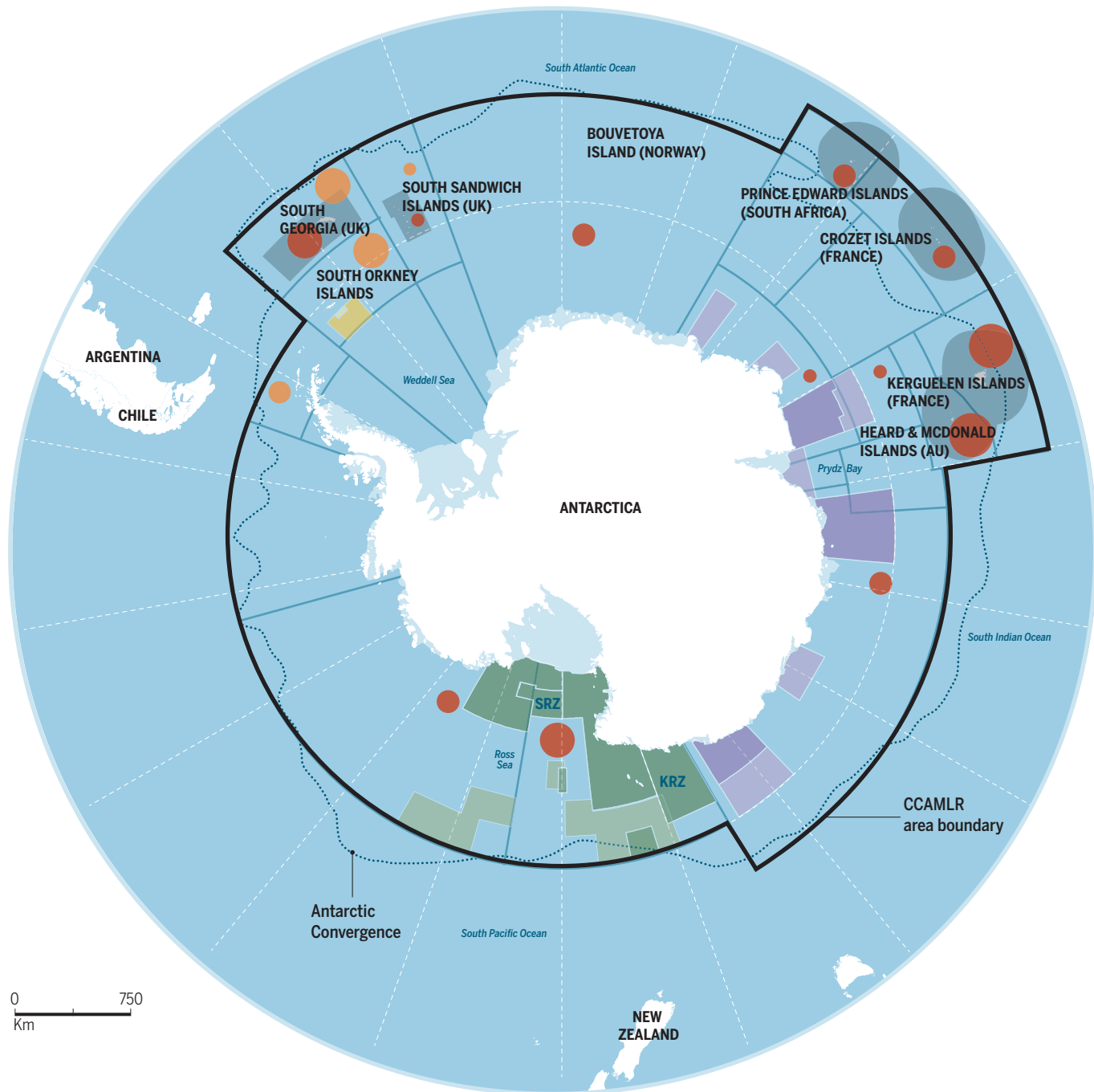
Russia, stated that "the amended MPA constitutes a good precedent" (12) because fisheries were not restricted. Other states objected to "the notion...that MPAs and fishing activities should be mutually exclusive" (12).

In 2012, CCAMLR considered MPA proposals in the Ross Sea and the East Antarctic. Both proposals were designed to protect ecological structure and function, with reference areas for evaluating climate change and fishery impacts, and both were deemed to be based on the best available science (2). Yet by 2015, the areas proposed for protection in the Ross Sea and the East Antarctic were reduced by 30 and 50%, respectively, with ecologically important areas omitted to enable fishing access (see the figure and fig. S1). Research fishing zones, which permit commercial fishing for toothfish and/or krill with additional requirements (e.g., increased fish tagging), were added to the Ross Sea MPA. These

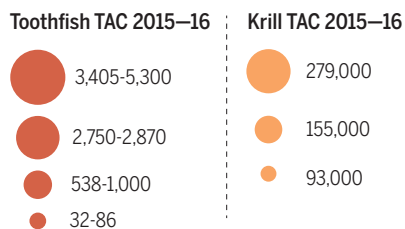
<sup>1</sup>Stanford University, Palo Alto, CA 94305, USA. <sup>2</sup>The Center for Ocean Solutions, Monterey, CA 93940, USA. <sup>3</sup>H. T. Harvey and Associates, Los Gatos, CA 95032, USA. <sup>4</sup>Royal Holloway, University of London, London, UK. <sup>5</sup>IUCN Global Marine and Polar Programme and World Commission on Protected Areas, Cambridge, MA 02138, USA. <sup>6</sup>University of British Columbia, Vancouver, BC, Canada. Email: cbrooks1@stanford.edu

## Fisheries and proposed marine protected areas in the Southern Ocean

CCAMLR's MPA concessions from 2012 to 2015. Total Allowable Catch (TAC) circle location is specified per subarea and does not represent the actual location of catch. CCAMLR boundaries, adopted MPA, and fisheries data from (18); Ross Sea MPA boundaries based on (19); East Antarctic MPA boundaries based on (20).



### Captures in metric tons



fishing zones encompassed foraging grounds for seabirds and whales and jeopardized a scientific reference area that had been proposed to measure fishery ecosystem effects (2) (fig. S1). Even though the East Antarctic MPA proposal employs a multi-use approach, it omitted no-take zones, and the area of highest conservation value, Prydz Bay, was removed during negotiations (see the figure).

Temporal concessions, or “sunset clauses,” have marred negotiations. MPAs are usually established in perpetuity, and their duration has been linked to ecosystem benefits (6). The largely terrestrial protected areas adopted via the Antarctic Treaty are permanent, as are nationally designated subantarctic MPAs. Although duration was not discussed during the 2009 South Orkney MPA negotiations, it has become a major barrier to consensus, with many CCAMLR fishing states asserting that MPAs must include an expiration date. China proposed a limit of 20 years (9), shorter than the life spans of most Antarctic top predators and inconsistent with the stated goals of the MPAs, as well as CCAMLR’s provisions for rational use. As of 2015, the proposed Ross Sea and East Antarctic MPAs have 50- and 30-year expiration dates, respectively.

Current MPA proposals only prohibit fishing in 3.2% of CCAMLR’s waters (see the figure) for a fixed period of time, yet consensus still lags. Past conservation successes in CCAMLR depended on having an open political window of opportunity, trust within the Commission, and alignment of incentives among member states (5). Yet, currently, states have become entrenched in their positions for or against MPAs, breaking trust. States blocking adoption of MPAs continue to do so even after concessions were made to meet those states’ requests (9), not negotiating in good faith. Negotiations have been tainted by geopolitical disputes elsewhere in the world (e.g., United States–Russia tensions over Crimea) (13). States proposing MPAs in their former territories have been accused of using political rather than ecological boundaries as a tool for asserting sovereignty (14).

This stalemate may reflect the scramble for Southern Ocean resources as other fisheries become less productive (13). As a commons, the Southern Ocean continues to be a contested space. Although CCAMLR was historically composed mainly of states without active fisheries in the Southern Ocean, membership has grown, member stances on fishing have changed, and it is now dominated by fishing states (2) whose national positions reflect intent on economic gain and asserting power while securing future access by occupying the Southern Ocean via fishing (13).

The idea of “rational use”—defined in the Convention as a mandate to employ precaution in resource exploitation, a critical part

of conservation—is being reinterpreted by several states to defend an unequivocal right to fish and to argue against MPAs that in any way restrict fishing access (15). Although CCAMLR’s historic precautionary management paradigm was not to allow fishing unless sufficient data was available to manage the fishery, MPA opponents are reversing the burden of proof, demanding that sufficient data be available to show that fishing is damaging the ecosystem to warrant an MPA that restricts fishing (9). If the current amended proposals are adopted, their concessions will compromise MPA effectiveness, thus undermining the conservation mandate of CCAMLR and the implementation of science-based marine management broadly.

### STABILIZING A KEYSTONE AGREEMENT

The Commission has a critical window of opportunity to uphold its status as a leader in resource management. We offer five recommendations for the upcoming meeting.

*Endorse only MPAs that are designed with the best available science and combine no-take areas with effective enforcement.* Ineffective MPAs that only “protect” ocean areas that may not have otherwise been heavily fished anyway undermine CCAMLR’s mandated best practices (7) and credibility while impairing the value of MPAs as a management tool.

*Establish MPAs in perpetuity.* CCAMLR’s MPA rules specify, “the period of designation...shall be consistent with the specific objectives of the MPA” (7). Proposed arbitrary sunset clauses of 20 to 30 years are insufficient for achieving MPA conservation objectives. Further, they will not meet internationally established criteria for protected areas (16) and thus may not qualify toward global MPA targets.

*Uphold CCAMLR’s mandate.* The Convention was designed as a conservation convention with fisheries management grounded in precautionary and ecosystem-based approaches (4). The use of closed areas “for purposes of scientific study or conservation” (4) is an essential component of ecosystem-based management. Redefinition of “conservation” as an unequivocal right to fish compromises the purpose of MPAs and the integrity of the Southern Ocean ecosystem and the high seas beyond.

*Rebuild trust through science.* The historic diplomatic and environmental success of CCAMLR and the broader ATS is fundamentally rooted in science (3). Science-based decision-making provides transparency and credibility and can reduce geopolitics within the forum. In adhering to its mandate for making conservation decisions based on the best available science, CCAMLR can rebuild trust and progress for MPA negotiations.

*Demonstrate leadership.* In adopting effective MPAs in the Ross Sea and the East Antarctic, CCAMLR could protect more than 2 million km<sup>2</sup>, 6% of the Southern Ocean. With proposals for additional MPAs under way, CCAMLR could become the first international marine management organization to meet global protection targets agreed to by the Convention on Biological Diversity (10% of waters protected by 2020) (17), of which almost all CCAMLR states are members. This precedent would inform the current United Nations’ development of a legally binding agreement for conserving marine biodiversity beyond national jurisdiction (17) and influence governance of emerging resource frontiers (e.g., the Arctic). In upholding CCAMLR’s charter, member states could safeguard Southern Ocean ecosystems and avoid destabilizing a keystone of science-based international environmental agreements. ■

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### SUPPLEMENTARY MATERIALS

[www.sciencemag.org/content/354/6309/185/suppl/DC1](http://www.sciencemag.org/content/354/6309/185/suppl/DC1)

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