Ross Sea Region Marine Protected Area Research Coordination Network
Annual 2026 Meeting Report

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Abstract

The Ross Sea region Marine Protected Area (MPA) Research Coordination Network (RCN) was established to strengthen international collaboration in support of research, monitoring, and management of the Ross Sea ecosystem. The second annual RCN meeting was held in April 2026 and brought together 128 participants from 23 countries representing diverse scientific disciplines, institutions, and partner communities. The primary goal of the meeting was to advance preparations for the 2027 ten-year review of the Ross Sea region MPA. Meeting activities focused on implementing the objective-based reporting framework for the review and advancing assessments associated with the eleven objectives of the MPA. Working groups identified priority datasets, indicators, analyses, and synthesis products needed to evaluate progress toward MPA objectives. The meeting strengthened international collaboration, refined priorities for the 2027 review, and established a coordinated pathway for delivering the scientific products needed to support the Ross Sea region MPA review.

Meeting Overview

To support research and monitoring in the Ross Sea region marine protected area (MPA), we have built a Research Coordination Network (RCN), which was officially launched in 2025. The RCN works to improve our understanding of the Ross Sea ecosystem structure and function and

to support research and monitoring in the Ross Sea region MPA. The RCN includes three key components: (i) policy engagement, (ii) community partner engagement, and (iii) integrated science comprising three themes: data science and cyberinfrastructure; biophysical modeling; and observations, which includes monitoring and process studies (Figure 1). These components are further defined in Brooks et al. (2024) (see also SC-CAMLR-43/BG/11). The report on the inaugural meeting was presented in WG-EMM-2025-31. Here we report on the 2nd meeting of the Ross Sea region MPA RCN.

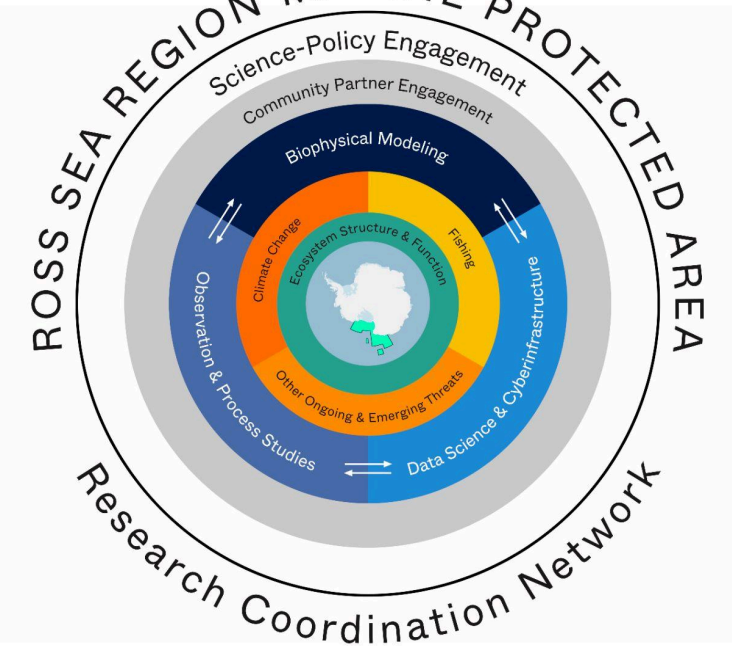

Figure 1. The Ross Sea region MPA Research Coordination Network (RCN) comprises three key components: policy engagement, community partner engagement (left), and integrated science which consists of data science and cyberinfrastructure, biophysical modeling, and observations, including monitoring and process studies (right). The placement of the Ross Sea region MPA at the center of the framework emphasizes the importance of understanding the structure and function of this ecosystem and its threats. The proposed framework for achieving policy-engaged science uses a policy (outer ring) and community partner informed coordination space (second outer ring), within which policy-relevant science (third ring inward) is conducted (Figure by John Weller).

During 27-30 April 2026 the annual meeting of the Ross Sea region MPA RCN was held in Estes Park Colorado. Ahead of the meeting, invitations to participate were shared widely across the Antarctic research community, including through SC-CIRC 26/10 and on RCN, SCAR and SOOS listservs. There were a total of 128 confirmed participants (54 in-person, and 74 online) from a total of 23 countries/regions: Argentina, Australia, Canada, Chile, China, Ecuador, Estonia, France, Greenland, India, Ireland, Italy, Korea, Malaysia, Monaco, Netherlands, New Zealand, Norway, Pakistan, Spain, United Arab Emirates, United Kingdom, and the United States (Figure 2). Participants included scientists from a wide range of career stages, disciplines and institutions as well as individuals from governmental, inter-governmental and

non-government organizations, along with representatives from other international organizations. The meeting was funded by the United States National Science Foundation through Award number ANT 2448649 which will continue to provide support for annual meetings of the RCN through 2029.

Figure 2. In-person participants at the annual meeting of the Ross Sea region MPA Research Coordination Network in Estes Park, Colorado, USA (photo credit: John Weller).

The overall priority for the 2026 meeting was to advance activities in support of the 2027 review of the Ross Sea region MPA and to continue to build the RCN to this end. Specific meeting goals were to:

- Continue to strengthen relationships in and across the RCN community
- Set priorities for all RCN Working Groups based on the objective-based reporting framework, the agreed framework by CCAMLR's Scientific Committee for the 10-year review.
- Advance priorities for each RCN Working Group during the meeting, including progressing reports for each MPA objective;
- Developing a communications strategy and a policy strategy.
- Develop a plan and timeline for completing Working Group activities in support of the 2027 Ross Sea region MPA review.
- Draft a summary report of meeting outcomes for broad distribution that summarizes priorities and activities of the RCN.

The list of participants and full agenda and schedule for the meeting is provided in Annex A.

Key Updates

All RCN components advanced work in the intersessional period. The policy engagement component reported continued engagement with CCAMLR, including the submission of papers to WG-EMM and the Scientific Committee proposing an objective-based reporting framework and schedule for the 10-year review (WG-EMM 2025/35, WG-EMM 2025/36, SC-CAMLR 44/BG/35). This framework was endorsed by WG-EMM and SC-CAMLR (SC-CAMLR-44, paras 6.1-6.3). Accordingly, the review process will assess progress toward the 11 objectives of the Ross Sea region MPA, including sub-objectives. Objective-based reporting templates were developed to evaluate the extent to which objectives have been achieved, and are still relevant, and to identify relevant indicators, data sets, analyses and visuals. Entering content into these templates formed the basis for the work progressed during the 2026 annual meeting. Further, the community partners component continued efforts to identify and engage community partners relevant to the Ross Sea region MPA review (elaborated on below).

The integrated science component of the RCN advanced work across all three science themes. The biophysical modeling component of the RCN progressed synthesizing available modeling approaches and preparing a collaborative review manuscript (Lovvorn et al. In Review, WG-EMM-26/XX). Emerging priorities for this working group include: Earth System Models, Forced Ocean Sea-Ice Simulations, sea ice–ecosystem interactions, benthic-pelagic coupling, and multi-scale ecosystem modeling. The observation and process studies component focused intersessionally on consolidating observational datasets including: predator tracking records, population census information, predator diet databases, krill distribution data, and ecosystem indicator development. Significant progress was reported toward: a Ross Sea predator diet synthesis, updated population assessments, standardized tracking databases and expanded ecological indicator frameworks. The data science and infrastructure component of the RCN continued development of the Big Blue Cloud platform, reported on further below.

Advancing Objective-based Reports

A substantial portion of the meeting focused on preparing for the 2027 Ross Sea region MPA review. Extensive time was spent in working groups focused on specific Ross Sea region MPA objectives. Notably, across all objective-based working groups, climate change emerged as the dominant ecological driver influencing ecosystem structure, species distributions, sea ice dynamics, and oceanographic processes. Participants stressed that future assessments must clearly communicate observed environmental changes and remaining uncertainties. There was also broad consensus that successful completion of the 2027 review depends upon coordinated access to datasets distributed across institutions and nations. The Big Blue Cloud cyberinfrastructure platform was seen as a critical mechanism for this collaboration and coordination. Further, working groups consistently identified opportunities to synthesize existing information rather than focusing solely on collecting new data.

For MPA Objectives i, ii and iii, the working group participants focused on ecosystem-scale synthesis efforts, since objectives i and iii apply to the entire MPA and involve whole ecosystem assessments. It was also acknowledged that the assessments for all of the other objectives would feed into the synthesis needed for objectives i, ii and iii.

For Objective i, which is focused on conserving ecological structure and function of the Ross Sea, progress towards developing a Ross Sea Ecological Index was discussed. Building on the foundation of Ballard et al. 2012 , this updated index will integrate newly available international at-sea observation data alongside recent biologging data. This expanded dataset captures critical life-history stages, including dispersal, migration, molt, and wintering, for key ecosystem indicator species like minke whales, killer whales, Weddell seals, and penguins. These species distributions will be combined with new preyscape information derived from fish and krill abundance surveys. A key advancement of this updated index is the integration of numerical model outputs for environmental covariates , which will enable the evaluation of potential future climate scenarios. Ultimately, the Ecological Index will allow for a robust, ecosystem-wide assessment of the Ross Sea, providing forward-looking insights into species richness, distribution, and conservation prioritization rankings.

Objective ii, which focuses on reference areas to study the impacts of fishing and climate change (including the Special Research Zone - SRZ) was also seen as having ecosystem-wide elements that would be covered initially with the review of SRZ in 2026. Other ecosystem-wide elements generally related to reference areas would be addressed in 2027 when assessments of the other objectives have been advanced. For example, the assessment of the SRZ links to objectives, i, iii, va,d, vi, and xi. Thus, multiple working groups, focused on different objectives, will collaborate towards completing their assessment to help inform the review of the SRZ (WG-EMM-2026/XX).

Objective iii, which focuses on promoting research and scientific activities, also covers the entire Ross Sea region and ecosystem. The objective iii working group discussed developing a comprehensive corpus of documents to train an AI system capable of answering questions about Ross Sea scientific outputs (such as quantity, diversity and impact of research). This effort would support both the upcoming 5-year report (2022–2026) and the 10-year review of research and monitoring activities. The corpus will include peer-reviewed publications, CCAMLR documents, funded grant proposals, project records, databases where appropriate, and all materials previously submitted for the 2022 five-year reporting process. Key outputs would be developed from this corpus of documents, in consultation with expert review, including a comprehensive summary of research findings and how the Ross Sea region MPA has influenced or motivated research activities.

For Objective iv, which focuses on representativeness of benthic and pelagic environments in areas with sparse data, the working group reviewed historical analyses used during MPA design

and discussed opportunities to update these assessments using modern datasets and analytical approaches. For benthic bioregions, it was discussed that there is new literature and thus the possibility of having additional layers. For pelagic bioregions, these will look different from 2010 given changes in sea ice and other changes over time. Both benthic and pelagic bioregions will need modeling support from the RCN. Understanding interactions between pelagic and benthic bioregions will be essential.

Objectives v and viii, which focus on large-scale ecosystem processes and coastal locations of ecological importance, respectively, were grouped together since most of the datasets and analyses identified would apply to both objectives. This group focused on the large-scale physical and biological drivers that influence ecosystem structure and function throughout the Ross Sea region. Priority topics included: sea-ice dynamics; hydrographic variability; ocean circulation patterns; ocean color and productivity; climatological trends; and cross-shelf transport processes. The working group for these objectives emphasized the importance of distinguishing between natural variability, long-term climate trends, and changes potentially relevant to MPA objectives. Participants identified substantial opportunities to improve historical analyses through modern observational products and reanalysis datasets. While many environmental variables were considered during MPA design, significantly improved data products are now available. The group also highlighted the importance of developing shared foundational datasets and figures that can support multiple review objectives simultaneously.

Objective vi which focuses on core distributions of trophically dominant pelagic prey species and Objective xi which focuses on krill, including in the Krill Research Zone, were also grouped together since they both assessed prey species. Participants concluded that substantial progress has been made toward achieving objectives vi and xi through extensive research efforts conducted over the past decade. Data from New Zealand, Korea, Italy, China, and historical U.S. programs provide a strong foundation for evaluating prey distributions and ecosystem dynamics. Major findings included: expanded knowledge of Antarctic and crystal krill distributions, new acoustic and net-sampling datasets, improved understanding of environmental drivers influencing prey species, and increasing availability of long-term oceanographic datasets that support interpretation of biological change. Antarctic silverfish emerged as a priority topic requiring additional synthesis. Although more information is available than historically, participants identified continued uncertainties regarding life-stage distributions, habitat use, and ecosystem significance. This working group also discussed updating historical distribution maps used during MPA design and incorporating newer observations from previously under-sampled regions, including the Krill Research Zone.

Objective vii focuses on protecting core foraging areas for top predators including Adélie penguins, emperor penguins, Weddell seals, and Type C killer whales. The objective vii working group focused on: defining appropriate spatial boundaries for species assessments, interpreting

summer and winter foraging distributions, incorporating juvenile and non-breeding life stages, addressing tagging biases and data limitations, data availability and gaps, and integrating predator responses to changing sea-ice conditions. Significant progress was made toward compiling available tracking, demographic, dietary, and habitat-use datasets. Participants reviewed biologging data, historical tracking records, and newly available datasets contributed through international collaborations. The group reached consensus that spatial analyses should be tailored to the ecology of individual species rather than constrained to a single geographic extent. Participants emphasized the importance of maintaining consistency where appropriate while ensuring scientific relevance. Priority actions included: completing species-specific report templates, incorporating updated tracking datasets into the Big Blue Cloud, expanding collaboration with killer whale experts and coordinating with the working groups focused on ecosystem processes and prey.

For Objective ix, which focuses on protecting areas of importance in the life cycle of Antarctic toothfish, the working group discussed: migration corridors, shelf and slope connectivity, population structure, tagging datasets, life-stage distributions, and diet and trophic interactions. The extensive work completed towards the Ross Sea toothfish stock assessment, including the Ross Sea shelf survey, times series and tagging data, will help inform this objective. Further, new literature on spawning and modeling on larval dispersal will add insights. The group identified opportunities to leverage fisheries-dependent and fisheries-independent datasets, stock assessments, and emerging analytical approaches such as microchemistry and spatial population modeling.

Objective x focuses on protecting known rare or vulnerable benthic habitats, including at specific locations (e.g., Balleny Islands, seamounts, McMurdo Sound). The group reviewed existing priority areas and discussed new information related to: seamount systems, methane seep communities, benthic habitat mapping, risk assessments, and fishing activity overlap, among others. New data is available for most regions, including from fisheries data, though some areas are still relatively data poor (e.g., Balleny Islands and adjacent seamounts). Other areas have extensive new benthic data, especially McMurdo Sound, including in areas deeper than 30m. The group noted that vulnerable and rare habitats are really abundant, but need models to elucidate. Species distribution models for benthic invertebrates (e.g., hard corals) could help.

Here is the updated paragraph, integrating the live workshop achievements directly into the flow of the existing text:

Data Science and the Big Blue Cloud: Ocean Motion Technologies and the Big Blue Cloud team provided updates on the development of the cloud-based data platform supporting the RCN. The Big Blue Cloud serves as a hub for data storage, visualization, analytics, AI applications, and collaborative dashboard development. Major advances intersessionally included the integration of oceanographic and ecological datasets, AI-assisted metadata generation,

standardized data sharing workflows, MODIS satellite product integration, enhanced visualization tools, and collaborative dashboard development. During the workshop, the platform also served as an active testing ground; approximately 15 new users were successfully onboarded, and their real-time feedback was utilized to implement immediate usability improvements. Participants highlighted the critical importance of open data documentation and standardized metadata. Acting on this, a significant technical milestone was achieved during the sessions: the creation of a controlled vocabulary for dataset tagging. By basing these keywords on the NASA Global Change Master Directory (GCMD), the platform now ensures highly standardized, discoverable, and interoperable data management moving forward. Participants viewed the platform as a critical component of future synthesis efforts and identified numerous opportunities for expansion. The platform will play a central role in supporting the Ross Sea region MPA review and future Ross Sea observing system development (see below).

National Program Presentations: RCN participants from China, South Korea, New Zealand, Italy, and the United States provided updates on ongoing and planned Ross Sea research activities by their respective national programs. Major activities include: Long-term monitoring of Adélie and emperor penguins; Weddell seal population studies; Antarctic toothfish surveys and tagging programs; krill and silverfish monitoring; oceanographic observations and moorings; sea ice and climate research; eDNA and ecosystem surveys; benthic habitat investigations; and marine mammal monitoring, among others. Participants emphasized the importance of continued international coordination and data sharing to maximize scientific return and support MPA evaluation efforts. Many individuals from these countries expressed interest in contributing datasets to the RCN and the Big Blue Cloud and supporting analyses relevant to the 10-year review. Presenters also expressed desires to collaborate internationally with the Ross Sea research community.

Community Partnerships and Outreach: The Community Partners Working Group refined priorities for outreach and engagement. They held a very productive interactive session during the RCN meeting aimed at developing a communications strategy. High-priority products were identified and include: a general Ross Sea RCN presentation deck; visual storytelling resources; website redevelopment; and social media content, among others. Policy briefs, short documentary videos, science synthesis reports, popular articles, and science communication training were also mentioned. There was agreement that a public media campaign should be held during 2027 to celebrate the 10-year birthday of the MPA. During the meeting, John Weller collected interviews with participants to use in media celebrating the Ross Sea. Priority events that could be leveraged include: the SCAR Open Science Conference, CCAMLR meetings, International Polar Year (IPY) activities, and a wide range of other international scientific and policy forums. Participants emphasized the need to communicate scientific outcomes, support funding opportunities, increase awareness of the MPA, and strengthen engagement with policymakers and the public.

Ross Sea Observing System. On the final day of the meeting, participants discussed potential opportunities to develop a coordinated Ross Sea observing system capable of supporting long-term ecosystem monitoring and future management needs. Potential components identified by the community include: bottom-moored biophysical moorings, biophysical gliders and other autonomous vehicles, hydrophones, animal borne sensors, biogeochemical floats, and ice-monitoring platforms. Many participants expressed willingness to share infrastructure and collaborate on future observing initiatives. Ocean Motion Technologies discussed emerging new developments of instrumented platforms that could be integrated into an eco-observatory, including wave-powered systems, autonomous sensing platforms, under-ice monitoring technologies, integrated data transmission systems, and real-time environmental monitoring networks. The group identified the observatory concept as a potentially important legacy initiative associated with the ten-year MPA review.

Silverfish funding opportunity. Participants received updates on the Silverfish Initiative, an effort designed to coordinate and fund scientific activities relevant to the Ross Sea ecosystem and MPA review process. The initiative has secured renewed support and has entered an establishment phase during 2026–2027. Planned activities include: competitive research funding, scientific synthesis projects, data integration efforts, and priority analyses supporting the 2027 review. A funding call was launched in early May 2026. Proposals are currently being reviewed. The initiative is intended to complement existing research investments while enhancing international science coordination and addressing priority knowledge gaps identified through the RCN process.

Conclusions

The annual Ross Sea region MPA RCN meeting demonstrated substantial progress toward preparation of the 2027 ten-year review while strengthening the international scientific community supporting the Ross Sea ecosystem. Specifically, the RCN progressed objective-based review templates aligned with the 11 objectives of the Ross Sea region MPA, with leaders committed to finalizing the reports. The RCN advanced collaborative synthesis efforts on predator ecology, prey dynamics, ecosystem processes, benthic habitats, and fisheries-related objectives. The community continued development of the Big Blue Cloud data infrastructure for data management and synthesis. Further, updates on Antarctic national programs highlighted significant ongoing and planned research activities across the Ross Sea. Participants contributed to the development of a coordinated communications and community engagement strategy. The meeting reinforced the importance of international scientific collaboration in supporting adaptive management of the Ross Sea region MPA in the face of accelerating environmental change, particularly climate-driven changes. The meeting successfully met its primary objectives and established a clear pathway toward completion of the scientific products required for the 2027 Ross Sea region MPA review. Participants left with

renewed momentum, clearly defined responsibilities, and a shared commitment to supporting science-based conservation of one of the world's most important marine ecosystems.

The RCN-wide communications will continue on the Ross Sea RCN listserv. Our next annual meeting is tentatively scheduled for 12-15 April 2027. The RCN will continue to bring updates to CCAMLR through regular reports to their scientific meetings. The Ross Sea region MPA RCN invites widespread engagement and collaboration with the CCAMLR community. Please email cassandra.brooks@colorado.edu to join the listserv (or with any questions or comments) and visit https://www.rosssearesearch.org/ to learn more.

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References

Ballard G., D. Jongsomjit, S.D. Veloz, & D.G. Ainley. 2012. Coexistence of mesopredators in an intact polar ocean ecosystem: The basis for defining a Ross Sea marine protected area, Biological Conservation 156: 72-82.

Brooks, C., S. Stammerjohn, G. Ballard, A. DuVivier, E. Hofman, M. La Rue, C. Nissen, A. Orona, B.J. Pan, A. Schmidt, N. Walker, G. Watters & J. Weller. 2024. Research and monitoring in remote large-scale marine protected areas: The Ross Sea region as a model system. *Conservation Letters*. e13053

Lovvorn, JR., Nissen, C., Bahl, AA., Behrens, E., Brooks, C.M., Christensen, K., Dinniman, M.S., Dove, L.A., DuVivier, A.K., Hofmann, E.E., Kwasniewski, H., Shin Kwon, Y., Stammerjohn, SE., Xing, L. In Review. End-to-end modeling for the Ross Sea Region Marine Protected Area: a review of available tools for conservation objectives. Frontiers in Marine Science.

SC-CAMLR-43/BG/11 by the Delegation of the United States. 2024. Building a coordinated framework for research and monitoring in large-scale international marine protected areas: The Ross Sea region as a model system.

SC-CAMLR-44/BG/35 by the Delegations of Italy, New Zealand, Republic of Korea, Norway and Argentina. 2025. The Framework and Science to support the 10-year review of the Ross Sea region MPA.

SC-CAMLR. 2025. Report of the forty-fourth meeting of the scientific committee. Hobart, Australia.

WG-EMM-2025/35 by Pardo, E., N. Walker, S. Lamping, L. Ghigliotti, J-H. Kim, C. von Quillfeldt, C. Brooks, M. Santos, M. Pinkerton, H. Weiskel, J. Fenaughty, S. Parker, P. Castillo-Briceno & M. Anderson. 2025. 2027 Ross Sea region MPA review - Requirements and science needed for objective-based reporting.

WG-EMM-2025/36 by Lamping, S., L. Ghigliotti, E. Pardo, N. Walker, J-H. Kim, M. Santos, C. von Quillfeldt, C. Brooks, H. Weiskel, J. Fenaughty, S. Parker, P. Castillo-Briceno & M. Anderson. 2025. A proposed framework to support the Ross Sea region MPA review.

ANNEX A. Agenda and Participant List

Participant list can be found HERE.

Agenda and Schedule can be found HERE.

Annex B. Timeline of national activities in collaboration with the RCN

2026

- Consolidate datasets and figures.
- Continue synthesis and analysis efforts.
- Develop initial draft science reports for each objective (and sub-objective).
- Complete support SRZ review science materials.
- Complete objective iii materials for supporting 5-year report & 10-year review.

Early 2027

- Finalize objective-based science reports.
- Support 5-year report documents.

- Integrate scientific findings across objectives.
- Support management-relevant synthesis products.

April 2027

- RCN annual meeting (tentatively scheduled 12-15 April)

Mid-2027

- Complete review documentation.
- Submit materials for CCAMLR consideration.
- Support CCAMLR Working Group and Scientific Committee discussions.

October 2027

- Formal presentation of materials for Ross Sea region MPA Ten-Year Review.