WORKSHOP ON MARINE CARBON DIOXIDE REMOVAL (WKMCDR; OUTPUTS FROM 2024 MEETING)

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International Council for the Exploration of the Sea
Conseil International pour l'Exploration de la Mer

H.C. Andersens Boulevard 44-46
DK-1553 Copenhagen V
Denmark
Telephone (+45) 33 38 67 00
Telefax (+45) 33 93 42 15
www.ices.dk
info@ices.dk

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Editors

Libby Jewett

Authors

Gabby Kitch • Helen S. Findlay • Helen Gurney-Smith • Kalina Grabb • Ken Paul • Libby Jewett • Nicole Cabana • Paul McElhany • Samantha Clevenger

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Contents

i Executive summary

Human activities increase greenhouse gas emissions, unequivocally causing the global climate to change. Scientific assessments state that in addition to steep emission reductions, carbon removal is also needed to limit the worst impacts of climate change that would result in irreversible impacts on ecosystems and livelihoods. There is a growing interest in research and development of marine carbon dioxide removal (mCDR), given the ocean's natural ability to absorb carbon dioxide. Marine carbon dioxide removal refers to approaches that use ocean processes to enhance the natural absorption of atmospheric carbon dioxide by the ocean (Ocean Climate Action Plan, OCAP, 2023; Fast Track Action Committee on Marine Carbon Dioxide Removal, FTAC, 2024). This field is rapidly expanding across private, public, and academic sectors, and many initiatives have thus far overwhelmingly focused on how to measure the efficacy of approaches against the complex natural variability of the ocean ecosystem. There remains a critical need to understand the potential impacts and potential benefits of mCDR on fisheries and aquaculture management and ecosystems. The ICES *Assessing/Anticipating the Impact of Marine Carbon Dioxide Removal (mCDR) on Fisheries and Aquaculture Species and Management Workshop* brought together participants across sectors, including mCDR and ocean acidification experts, fisheries managers, fisheries industry representatives, Indigenous groups, and academic and government fisheries and aquaculture scientists. At this multi-day virtual workshop, participants learned from each other through presentations and engaged in discussions, breakout sessions, and written activities to identify key takeaways. The workshop focused on four types of mCDR: ocean alkalinity enhancement, ocean nutrient fertilization, direct ocean capture, and macroalgae cultivation and sinking (National Academies of Science, Engineering, and Medicine, NASEM, 2021). The topics that were discussed at this workshop included:

- Overview of mCDR technologies
- Current mCDR case studies
- Blue carbon in relation to mCDR
- Possible effects of mCDR techniques on marine fisheries and aquaculture species and ecosystems
- Rightsholders and invested community perceptions of mCDR
    - International and national governance of mCDR and impacts on marine species
    - Indigenous considerations and solutions for mCDR
    - Fisheries and aquaculture invested in community considerations of mCDR

This workshop closed by discussing the key takeaways and desired next steps to assess and anticipate possible impacts of mCDR on fisheries and aquaculture species and management. The participants are interested in developing an ICES mCDR Working Group and hosting an in-person ICES mCDR workshop to carry out the desired next steps.

Through this workshop, participants acknowledged the urgent need to continue discussing mCDR in the context of fisheries and aquaculture management and coastal planning. This workshop intentionally brought together representatives from invested groups to provide a space to discuss the topics and learn from each other. Continuing this work to share knowledge and coproduce content with invested communities and rightsholders is valuable to ensure that mCDR research and development is done equitably and holistically.

ii Expert group information

Expert group name	Workshop on marine Carbon Dioxide Removal (WKmCDR)
Expert group cycle	Annual
Year cycle started	2024
Reporting year in cycle	1/1
Chair	Libby Jewett, US
Meeting venue and dates	16-18 October 2024, Woods Hole, MA, online, 90 participants

1 Introduction

The international scientific community's consensus suggests that carbon dioxide removal (CDR) plays a critical complementary role to emissions reduction to achieve net negative carbon dioxide (CO_2) emissions (IPCC, 2023), which is increasingly essential to achieving emissions scenarios that meet Paris Agreement warming targets (UNEP, 2024). Interest is growing in Marine Carbon Dioxide Removal (mCDR) as researchers question whether the ocean's natural ability to absorb carbon dioxide over large temporal and spatial scales could be enhanced. Several mCDR techniques are rapidly gaining research and commercial interest, such as ocean alkalinity enhancement, ocean nutrient fertilization, direct ocean capture, and macroalgae cultivation and sinking (NASEM, 2021; Cross *et al.*, 2023). Interest is developing in commencing and expanding field trials, which remain limited in spatial and temporal scope and constrained to national waters. Yet, more information is needed to determine if these techniques can effectively and safely enhance the ocean's ability to draw down atmospheric carbon dioxide on climate-relevant scales.

Additionally, more foundational natural and social science research is needed to investigate how mCDR-related activities impact environmental and ecosystem responses and societal and community changes. Understanding biological outcomes is emerging as a priority for researchers and invested communities. In parallel, researchers and governments are developing governance frameworks to oversee this new activity, which may have consequences for other existing ocean uses (Webb, 2024; FTAC, 2024; Johnson *et al.*, 2024).

This workshop was the first multinational and multi-sector meeting to explore the intersection of mCDR approaches and effects on marine fisheries and aquaculture. To ensure that mCDR activities now and in future, potentially at larger scales, are conducted to minimize potential negative effects on fisheries, this workshop brought together interested groups across sectors to discuss the research priorities related to mCDR and fish, fisheries, and aquaculture. This area has not yet received much dedicated attention although there is a natural overlap and relevance between the fields. As the mCDR field is growing, there have been ongoing conversations within the wider mCDR community about a number of challenges and areas of research that deserve additional focus, including, but not limited to: contrasting the complex natural variability of the ocean ecosystem; designing measurement, monitoring, reporting, and verification (MMRV) protocols focused on carbon removal; advancing technology developments for mCDR approaches; and assessing the feasibility and life cycle analysis of techniques. These topics and discussions have informed the scope and relevance of this workshop. Overall, the purpose of this workshop was to:

- Raise the visibility of mCDR in the ICES community;
- Initiate additional publications on the state of science and knowledge gaps focused on the potential effects of mCDR on fisheries and aquaculture species and management;
- Consider recommendations for ICES countries on how to engage with mCDR;
- Engage with a broad spectrum of interested parties, including fishers, fisheries managers, and Indigenous groups or representatives; and
- Develop plans for follow-up activities to continue the conversation on mCDR within ICES.

This workshop report lays out the workshop's planning and process. The workshop participants will create follow-up activities and products (as described in 'Workshop Conclusions and Next Steps') that touch on the state of the science, discussion content, and outcomes.

2 Workshop Process and Logistics

This workshop topic - the intersection of mCDR and fisheries - was first proposed to ICES in January 2024 by US NOAA Northeast Fisheries Science Center scientists. A workshop Steering Committee comprised academic and government researchers from the US, UK, and Canada. The steering committee members recognized an important large gap in the mCDR field related to fisheries, fishery management, and aquaculture because potential future large-scale mCDR implementation could affect managed fisheries and aquaculture species. These questions extend beyond a single scientist or discipline, requiring broader, internationally coordinated efforts to explore the cross section between mCDR and marine industries and ecosystems. The steering committee met weekly three months before the October 2024 workshop to design the workshop content, invite participants, and determine the scope and desired outcomes of the workshop. The Steering Committee members have all worked previously on the mCDR topic and/or related scientific issues, such as ocean acidification.

Since engaging a broad audience across disciplines from various ICES Member Countries was necessary, the Steering Committee invited participants with diverse geographic and occupational backgrounds and planned a virtual meeting lasting four half days to encourage broad participation and minimize financial barriers and travel-related emissions. In total, around 98 participants were invited from the following categories (note that participants could fall under multiple categories): mCDR or ocean acidification scientific expert (33), fisheries manager (13), fisheries industry representative (11), Indigenous groups or representation (9), and/or a scientist in academia, government fisheries, or aquaculture (34). Of the 98 participants invited, between 60 and 81 people attended the workshop daily.

The agenda was designed to be accessible to participants of all backgrounds, even those without prior exposure to mCDR. It included presentations from experts on the current state of science, breakout sessions, and opportunities for discussion, questions, and input through verbal discussions, written chats, and written mural boards (an interactive online shared working space).

At the beginning of each day, there were multiple-choice, ranked-choice, and open-ended poll questions, and the anonymized results were shown to all participants in real time. These questions helped workshop participants learn about each other and understand the diverse perspectives on mCDR and fisheries or aquaculture. Figure 1 displays data on the participants that was collected through these polls. In addition to questions about where the participants were from, and their professional interests, the poll questions included the following:

- What is your knowledge of mCDR?
- What do you think is the relative potential of these mCDR methods to remove CO2 at a large-scale?
- What do you think is the relative level of ecological impacts of each of the mCDR methods?
- How would you characterize existing mCDR permitting processes?
- How would you characterize the general perception of mCDR in your primary organization/community?
- How do we engage communities on mCDR?
- What do you think is the percent chance that mCDR will be implemented at the gigaton scale by 2050?
- What are the top three issues we must consider regarding mCDR and fisheries?
- What relevant issues do you think were missed or under-discussed at this workshop?

Results from these polls will be incorporated into future papers summarizing workshop takeaways.

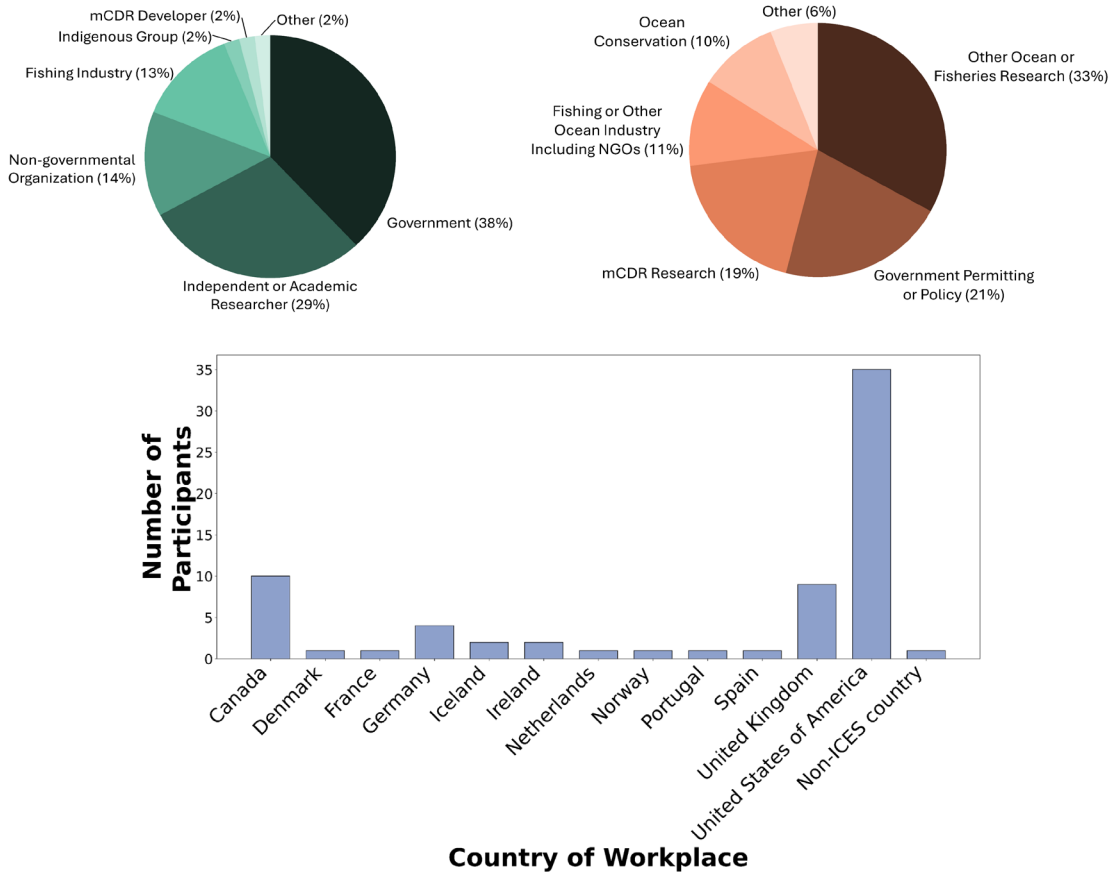

Figure 1: Results from polls during day one of workshop. Answers to multiple choice questions: What are your primary organizations? (upper left); What do you do? (upper right); and Where are you from? (choice to choose from all ICES countries, bottom). Answers for the top two graphs are displayed in percentages of total respondents and the bottom graph shows total count. A total of 69 respondents answered these questions.

3 Overview of mCDR

The workshop opened with expert presentations that served as an overview of mCDR needs, technologies, and select case studies. This session presented a background on mCDR to provide all participants with the same information and establish common ground for discussions. NOAA mCDR Lead Gabby Kitch provided a high-level overview of the motivation to study CDR to meet climate targets. Plymouth Marine Laboratory scientist Helen Findlay followed up with a more in-depth discussion about the mCDR techniques (NASEM, 2021).

While cutting greenhouse gas emissions is paramount, CDR is needed to meet climate goals under all emissions scenarios (IPCC, 2023). To meet these climate goals, steep emission reductions must be paired with around 9 gigaton (Gt) of carbon removal per year by 2050 and about 17 Gt of carbon removed yearly by 2100. Given that the ocean covers 70% of the planet and has naturally absorbed around 30% of the carbon dioxide emissions since the industrial revolution, the ocean may offer a large potential to remove carbon dioxide from the atmosphere. Effective mCDR techniques could leverage two known oceanic carbon uptake processes, either inorganic or biological, yet all pathways still require additional research and development. For this workshop, we focused on four mCDR pathways:

- Ocean alkalinity enhancement (OAE; inorganic);
- Direct ocean capture (DOC; inorganic);
- Macroalgae cultivation and sinking (biological); and
- Ocean nutrient fertilization (biological).

The current state of research and major funding opportunities regarding these four techniques were presented, including the potential effectiveness of CDR, cost range, state of permitting, potential benefits, potential impacts, and unknown factors. NOAA has supported a pathway-agnostic portfolio of mCDR research in the United States to help investigate the effectiveness and safety (ecologically and for communities) of various mCDR techniques. However, there are still massive research gaps across all techniques to understand the potential environmental, social, economic, and ecological effects, lessons learned from natural analogues, and the guidelines and requirements for monitoring, reporting, and verification (MRV). Discussing these opening presentations offered insights, challenges, and lessons learned about the mCDR methods.

3.1 mCDR Case Study

Following the mCDR overview, Woods Hole Oceanographic Institution (WHOI, a non-profit research institution) scientist Adam Subhas presented a case study on a collaborative project that he is leading at WHOI that is researching the effectiveness and environmental effects of OAE (Locking away Ocean Carbon in the Northeast Shelf and Slope, LOC-NESS). This project comprises a team of 20+ engineers, scientists, and communicators with no industry partners or incentives for carbon credits. This case study presented the project's overall goals, emphasizing the researchers' goal to conduct field research to evaluate OAE effectiveness, engage with communities, and conduct ocean modelling to expand the overall understanding of the potential impacts and benefits of OAE. LOC-NESS has conducted regional assessments to understand the physical, chemical, and biological aspects and vessel traffic to help choose experimental field sites. This presentation also focused on the aspects of the project that the researchers have prioritized, including local community and regulatory agency engagement. Subhas also touched on the team's experience submitting a research permit application to the Environmental Protection Agency (EPA) pursuant to the Marine Protection, Research and Sanctuaries Act (MPRSA). This

presentation spurred lively conversation on topics across science (environmental and ecological effects, MRV, durability), governance frameworks, and finance (research funding, costs for scaling).

3.2 Blue Carbon in relation to mCDR

The research community has various perspectives on whether blue carbon ecosystems or coastal and marine ecosystems that take up and store carbon dioxide from the atmosphere and store it should be considered separately from mCDR techniques. While this workshop did not include blue carbon restoration as an mCDR technique, a presentation by Laura Sordo from the Portuguese Institute for Sea and Atmosphere (IPMA) was included to highlight the role of blue carbon as a carbon sink. This presentation focused on blue carbon ecosystems such as seagrasses, saltmarshes, and mangroves and how they naturally store carbon below the ground while also providing other services, including coastal protection, water quality, nutrient recycling, sediment trapping, and habitat provision. Protecting and restoring these ecosystems is necessary to prevent the release of carbon back into the atmosphere from microbial degradation of organic material. The presentation and discussion focused on whether blue carbon should be a climate solution and/or an mCDR technique, considering topics related to different blue carbon techniques, blue carbon financing, seaweed cultivation, the combination of blue carbon with other CDR methods, restoration, and co-benefits. For this workshop, blue carbon was not considered further in mCDR discussions, given the difference in the maturity of the fields, the limited potential for blue carbon to scale to Gt removal, and the necessity of ongoing intervention for mCDR to remove carbon dioxide from the atmosphere and store it long-term.

4 Possible effects of mCDR on marine fisheries and aquaculture

To focus on the possible effects of mCDR on marine fisheries, aquaculture species, and ecosystems, this workshop dedicated one half-day to breakout rooms to encourage participants to discuss these topics in depth. Participants were distributed across the breakout rooms to ensure equal representation across the sectors in each room. The discussions were scheduled to focus on the four mCDR techniques: OAE, DOC, ocean nutrient fertilization, and macroalgae cultivation and sinking. Across each of these techniques, the discussions were guided by four main questions:

1. *What are the perceived or known benefits or risks to fisheries and aquaculture species of each mCDR method?*
2. *What categories of species do you think are at most risk (pelagic, benthic, shellfish, marine plants, coastal, offshore, invertebrates, fish)?*
3. *What are the key gaps, if any, in this knowledge, and what research is needed to address this (recommendations)?*
4. *Which culturally or economically important species are most at risk if mCDR is moved to the operational phase?*

For each breakout session throughout this meeting, there were three facilitators: two to guide the discussion and one to monitor the online chat and take notes. Each session also had a dedicated Mural board where participants could write their ideas and interact with each other's ideas. For each mCDR technique, all breakout sessions synthesized their discussion into three key takeaways. These key takeaways across all breakout sessions and mCDR techniques were consolidated and reviewed on the final day with all participants. Based on further group discussion, overall takeaways on the possible effects of all the mCDR techniques on fisheries and aquaculture were developed and prioritized.

5 Perceptions and uses of Rightsholders and invested communities

This workshop section featured presentations and focused discussions on international and national governance, Indigenous considerations and solutions, and fisheries and aquaculture considerations related to mCDR. The outcome of these sessions was focused on takeaways that were formed during the discussions and on a Mural board.

5.1 International and national governance of mCDR

Romany Webb from the Sabine Center for Climate Change Law and Columbia University presented the key international policy regimes relevant to mCDR. While no binding international agreements are specific to mCDR, several have implications for mCDR research and activities. For example, while the UN Framework Convention on Climate Change (UNFCCC) has focused on stabilizing greenhouse gas emissions, interest has grown in the legal community around efforts to remove carbon dioxide via enhancing carbon sinks. Other international agreements, such as the UN Convention on the Law of the Sea (UNCLOS), obligate states to address climate change. Additionally, the London Convention/London Protocol (LC/LP) regulates dumping and, through an amendment, specifically restricts ocean iron fertilization (OIF) to only allow research. Additional methodologies are now under consideration to be included under the LC/LP, which could result in a restriction to research-only activities for techniques such as OAE and macroalgae cultivation and sinking.

To focus on an example of a domestic regulatory regime, Sena McCrory from the US Environmental Protection Agency presented on the regulation of mCDR activities under EPA-administered statutes with a focus on the permitting process under the Marine Protection, Research, and Sanctuaries Act (MPRSA) which implements the requirements of the London Convention in the United States. The MPRSA permitting process includes coordination and consultation with Tribes, federal agencies, and state agencies and a public notice and comment period. MPRSA permits generally include requirements for monitoring and reporting of the authorized activities, as well as other EPA-specified requirements.

Following the introduction to EPA's regulatory framework, Mike Johnson from the US NOAA Greater Atlantic Regional Fisheries Office presented the regulatory actions that pertain to protecting Essential Fish Habitats (EFH). In accordance with the Magnuson-Stevens Fishery Conservation and Management Act, US federal agencies consult with NOAA on proposed actions that may adversely affect EFH and provide recommendations to offset these actions. Under the Endangered Species Act (ESA), groups acting must consider any potential species present in the action area and what direct and indirect effects of the action may be on endangered species in critical habitats.

5.2 Indigenous Considerations and Solutions for mCDR

To incorporate the perspective of Indigenous groups into this workshop, this session opened with Brad Warren from Global Ocean Health, who has focused heavily on mCDR and has worked with US Tribes for a long time. He shared a perspective from Terry Williams, from the Tulalip Tribe, who encouraged Tribal and other Indigenous groups to get ahead of mCDR implementation to build their chosen future. He shared that there are both risks and opportunities for Tribal Nations, given that there are contemporary resource management paradigms that need

to institutionalize active co-authorship of governance with Tribal Nations. He notes that ICES and this workshop community can potentially increase opportunities for Indigenous communities in this field.

Ken Paul from the Wolastoquey Nation at Neqotkuk, Pokiok Associates, shared an Indigenous knowledge framework that addresses the four directions of societal balance built upon individual balance. The key is for all issues to strike a balance between the different axes and to consider the life cycle of all endeavors. Society tends to overemphasize economics, technology, knowledge systems, and politics while focusing less on the social, community, biodiversity, culture, and environment. The mCDR community must prioritize a balanced focus on the social, community, biodiversity, cultural, and environmental aspects. Specifically, those who want to work with Indigenous communities will find that they will have to focus more on the communities, culture, and environment.

5.3 Fisheries and aquaculture perceptions

To provide a fisheries perspective, Elena Balestri from the Scottish Fisherman's Federation presented the concerns and needs she knows of within the Fisherman's Federation. The Scottish Fisherman's Federation represents more than 450 vessels and covers inshore fisheries, scallop dredgers, and pelagic fisheries. While the fishing community has tried to be proactive in preparing for the future of mCDR, mCDR activity has grown rapidly, and more engagement with the fishery industry and community is needed. Many in the fishing community worry that mCDR may threaten fisheries species, livelihoods, and ocean use and wish to be included in decision-making around mCDR activities. There is a need for the mCDR community to engage with the fishing community at early stages (e.g. pre-permitting) and use appropriate intermediaries, such as fishing councils. There is also a need to balance regulatory frameworks to ensure fairness between the static infrastructure (e.g. windfarms and potential future mCDR infrastructure) and seasonal permits for fishing, which have historical access. Fishing communities seek meaningful engagement and inclusion in the conversations, contributions, and decisions surrounding mCDR research scaling and potential future activities.

6 Workshop Conclusions and Next Steps

The workshop's final day was dedicated to wrapping up discussions about the sessions and identifying key takeaways. The Steering Committee presented the key takeaways from each session, and participants were provided time to read, add, and interact with the key takeaways on a mural board. Participants also weighed in on the desired next steps, which include consolidating the conclusions and key takeaways from this workshop into future activities and reports. The activities that participants were interested in pursuing include:

- Create an ICES mCDR Working Group; and
- Host an in-person ICES workshop in mid-2025.

Through these avenues, participants are interested in addressing the following tasks and topics:

- Create products and papers that communicate the key takeaways from this workshop and the state of mCDR science;
- Develop recommendations for ICES countries on how to engage with mCDR;
- Produce a systematic research design framework for fisheries and aquaculture responses;
- Define the state of knowledge of the potential effects of mCDR;
- Draft a framework to address mCDR trade-offs;
- Design a product for regulators or different coastal user groups related to mCDR; and
- Pursue additional content and topics that interest the working group participants.

Overall, this workshop underscored the urgency of continuing the conversation about the potential effects of mCDR on fisheries and aquaculture species and management. While this is the first workshop that provides a high-level overview of the issue, future activities will allow more in-depth discussions about the overlap between mCDR, fisheries, and aquaculture.

Reference list

Cross, J.N., Sweeney, C., Jewett, E.B., Feely, R.A., McElhany, P., Carter, B., Stein, T., Kitch, G.D. and Gledhill, D.K. (2023) 'Strategy for NOAA Carbon Dioxide Removal (CDR) Research: A White Paper documenting a potential NOAA CDR Science Strategy as an element of NOAA's Climate Interventions Portfolio.' Edited by the United States. National Oceanic and Atmospheric Administration. doi:10.25923/gzke-8730.

Fast Track Action Committee on Marine Carbon Dioxide Removal (2024) 'National Marine Carbon Dioxide Removal Research Strategy,' Subcommittee on Ocean Science and Technology National Science and Technology Council [Preprint].

Intergovernmental Panel on Climate Change (IPCC) (2023) Climate Change 2022 – Impacts, Adaptation and Vulnerability: Working Group II Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. 1st edn. Cambridge University Press. doi:10.1017/9781009325844.

Johnson, M., Doorn, E. van, Hilmi, N., Marandino, C., McDonald, N., Thomas, H., et al. (2024). Can coastal and marine carbon dioxide removal help to close the emissions gap? Scientific, legal, economic, and governance considerations. Elem Sci Anth, 12(1). https://doi.org/10.1525/elementa.2023.00071

National Academies of Sciences, Engineering, and Medicine (NASEM) (2022) A Research Strategy for Ocean-based Carbon Dioxide Removal and Sequestration. Washington, D.C.: National Academies Press, p. 26278. doi:10.17226/26278.

Ocean Climate Action Plan (OCAP) (2023) Ocean Climate Action Plan; A Report by the Ocean Policy Committee. The White House.

Romany M. Webb, International Governance of Ocean-Based Carbon Dioxide Removal: Recent Developments and Future Directions, Sabin Center for Climate Change Law, Columbia Law School, April 2024. Available at: https://scholarship.law.columbia.edu/sabin_climate_change/216

United Nations Environment Programme (UNEP) (2024). Adaptation Gap Report 2024: Come hell and high water —As fires and floods hit the poor hardest, it is time for the world to step up adaptation actions. Nairobi. https://doi.org/10.59117/20.500.11822/46497.

Annex 1: List of participants

Name	Institution	Country
Adam Holland	Northern Ireland Fishermen's Federation	Ireland
Adam Subhas	WHOI	USA
Alicia Cate	NOAA general counsel	USA
Andrij Horodysky	NOAA NEFSC	USA
Anuja Kapoor	DFO	Canada
Betsy Valente	EPA Office of Water	USA
Brad Warren	Global Health Partnership	USA
Caira Clark	DFO	Canada
Carla Guenther	Maine Center for Coastal Fisheries	USA
Charles Galdies	University of Malta	Malta
Chloe Dean	Woods Hole Oceanographic Institution	USA
Colin Warwick	fisheries consultant	UK
Daryl Williams	Tulalip Tribes	USA
David Keller	Carbon to Sea	USA
Debora Iglesias-Rodriguez	UC Santa Barbara	USA
Diana Perry	NOAA	USA
Dustin Delano	New England Fishermen's Stewardship Association	USA
Elena Balestri	Scottish Fisherman's Federation	Scotland
Elizabeth Methratta	NOAA/NEFSC	USA
Evin McGovern	Marine Institute	Ireland
Fabrice Pernet	Ifremer	France
Fiona Culhane	OceanICU	Ireland
Fiona Hogan	RODA	USA
Gabby Kitch	NOAA	USA
Gary Morishima	Quinault Management Center	USA/First Nation
Giulia Faucher	GEOMAR	Germany
Greg Jeddore	Miawpukek Mi'kamawey Mawi'omi	First Nation Canada

Name	Institution	Country
Guy Hooper	Plymouth Marine Laboratory	UK
Hank Soule	Offshore Lobsterman Associations	USA
Helen Findlay	PML	UK
Helen Gurney-Smith	DFO	Canada
Helene Gomes	AZTI	Spain
Hrönn Egilsdóttir	Marine and Freshwater Research Institute	Iceland
Irene Polyni	Carbon to Sea	USA
Iria Gimenez	Hakai Institute	Canada
Jeff Kaelin	Lund Fisheries	USA
Jon Hare	NOAA	USA
Josean Fernandes	AZTI Sukarrieta	Spain
Joseph Caracappa	NOAA	USA
Julia Brydon	ECCC (Environment Canada and Climate Change)	Canada
Justin Tiano	Wageningen Marine Research	Netherlands
Kalina Grabb	WHOI/NOAA	USA
Kathy Mills	GMRI	USA
Ken Paul	Pokiok Associates	First Nation/Canada
Kerri Weida	NOAA	USA
Laura Sordo	IPMA	Portugal
Lauren Apollaro	CEA Consulting	USA
Libby Jewett	NOAA	USA
Lina Röschel	Research Institute for Sustainability – Helmholtz Centre Potsdam	Germany
Lydia Kapsenberg	CEA Consulting	USA
Maria Ching Villanueva	Ifremer	France
Martina Stiasny	NOC	UK
Martine Lizotte	DFO	Canada
Matthew Gale	ECCC (Environment Canada and Climate Change)	Canada
Mattias Cape	Environmental Defense Fund	USA
Meghan Lapp	Seafreeze	USA

Name	Institution	Country
Michelle McClure	NOAA/PMEL	USA
Mike Johnson	NOAA GARFO	USA
Mireia Valle	AZTI	Spain
Nicolas Rolland	DFO	Canada
Nicolas Smith-Sanchez	GEOMAR	Germany
Nicole Cabana	NOAA	USA
Nina Bednarsek	OSU	USA
Paul Langdon	Ulnooweg	First Nation Canada
Paul McElhany	NOAA	USA
Peter Edwards	PEW	USA
Peter Haugen	IMR	Norway
Raymond Hall	Scottish Whitefish industry; Renewable energy policy officer	Scotland
Rod Wilson	University of Exeter	UK
Roger Griffis	NMFS	USA
Romany Webb	Columbia University	USA
Rufus Danby	Scottish White Fish Producers Association	Scotland
Salome Hallfredsdottier	Rost Marine Research Center	Iceland
Sam Clevenger	NOAA	USA
Sara Ednie	ECCC (Environment Canada and Climate Change)	Canada
Sarah Cooley	Ocean Conservancy	USA
Sarah Schumann	Fishery Friendly Climate Action	USA
Sarah Weisberg	NOAA	USA
Sena McCory	EPA	USA
Sevrine Sailley	PML	UK
Shallin Busch	NOAA-NWFSC	USA
Sian McGuinness	Marine Management Organization	UK
Suzanne Agius	ECCC (Environment Canada and Climate Change)	Canada
Tacey Hicks	NOAA/NMFS	USA
Tarsila Seara	NOAA social science	USA

Name	Institution	Country
Thomas Hurst	NOAA	USA
Tim Dudeck	Leibniz Centre for Tropical Marine Research (ZMT)	Germany
Wiley Evans	Hakai Institute	Canada
Zachariah Seville	DFO	Canada

Annex 2: Resolutions

2024/WK/EPDSG05 A Workshop **on marine Carbon Dioxide Removal** (WKmCDR), chaired by Libby Jewett, US will be established and will meet on 16-18 October in Woods Hole, MA, USA to:

a. Review and evaluate intersection between proposed marine Carbon Dioxide Removal (CDR) and fisheries; and fisheries management; (Science Plan codes: 2.7, 7.3, 2.1);

b. Review existing and proposed national and international regulatory and permitting frameworks for marine CDR (Science Plan codes: 2.7).

c. Consider whether an ICES WG should be established

Other Workshop Steering Committee members include: Lena Bergström, Sweden; Rudi Voss, Germany; Helen Findlay, UK and Mireia Valle and Guillem Chust, Spain; Jon Hare, Paul McElhany and Gabby Kitch, US.

Supporting information

Priority	The workshop proposed by this Group will allow ICES members to better understand the ecosystem-based fisheries management implications of proposed marine Carbon Dioxide Removal projects and technologies and determine whether an ICES Working Group is warranted.
Scientific justification	To meet the climate targets established through the UNFCCC Paris Climate Accord, carbon dioxide must be actively removed from the atmosphere in addition to implementing robust renewable energy targets. There is an active global effort to explore how to harness the ocean to do this in addition to direct air capture, afforestation and other land-based approaches. The United States recently released an Ocean Climate Action Plan and stood up a marine CDR interagency task force to explore options. How the implementation of mCDR projects at scale will intersect or conflict with fisheries management is an open question which this workshop will consider.
Resource requirements	Investment in marine CDR research is underway although funding for a workshop is needed. NOAA can host the workshop at its facilities in Woods Hole, MA.
Participants	Likely up to 50 participants – including researchers, industry representatives and fisheries managers from national governments.
Secretariat facilities	None.
Financial	No financial implications.
Linkages to advisory committees	There are no obvious direct linkages with the advisory committees.
Linkages to other committees or groups	ICES WGs to be approached about intersections include Aquaculture, Benthos Ecology, Fisheries Resources, Marine Chemistry, Deep-water Ecology, Marine Planning and Coastal Zone Management, and Phytoplankton and Microbial Ecology, ICES-PICES Strategic Initiative on Climate Change Impacts on Marine Ecosystems, Ecosystem Effects of Fishing Activities, Climate Change Considerations in Marine Spatial Planning.
Linkages to other organizations	NGO – Ocean Visions; NOAA Ocean Acidification Program (where US government funding for marine CDR is being governed), Ocean Carbon and Biogeochemistry Program at Woods Hole Oceanographic Institute, AGU/EGU, related Ocean Decade programs including the Global Ocean Negative Carbon Emissions (Global-Once) Program.