

Co-production of knowledge and strategies to support climate resilient fisheries

Katherine E. Mills ^{1,*}, Derek Armitage ², Jacob G. Eurich ^{3,4}, Kristin M. Kleisner ⁵,
Gretta T. Pecl ^{6,7} and Kanae Tokunaga ¹

¹Gulf of Maine Research Institute, 350 Commercial St. Portland, ME 04101, USA

²School of Environment, Resources and Sustainability, University of Waterloo, 200 University Ave W, Waterloo, ON N2L 3G1, Canada

³Environmental Defense Fund, Santa Barbara, CA 93106, USA

⁴Marine Sciences Institute, University of California, Santa Barbara, CA 93106, USA

⁵Environmental Defense Fund, 18 Tremont St. Suite 850, Boston, MA 02108, USA

⁶Centre for Marine Socioecology, University of Tasmania, Hobart 7005, Australia

⁷Institute for Marine and Antarctic Studies, University of Tasmania, Hobart 7005, Australia

*Corresponding author: tel: +1 207 228 1657; email: kmills@gmri.org

Knowledge co-production offers a promising approach to design effective and equitable pathways to reach development goals. *Fisheries Strategies for Changing Oceans and Resilient Ecosystems by 2030* (FishSCORE), a United Nations Ocean Decade programme, will co-produce knowledge that advances solutions for climate resilient fisheries through networks and partnerships that include scientists, stakeholders, practitioners, managers, and policy experts. FishSCORE will establish (1) a global network that will develop broadly relevant information and tools to assess and operationalize climate resilience in marine fisheries and (2) local and regional partnerships that will apply those tools to identify and forward context-specific resilience strategies. FishSCORE's activities will be guided by a set of core principles that include commitments to inclusivity, equity, co-leadership, co-ownership, and reciprocity. FishSCORE will focus on identifying solutions for climate resilient fisheries, and it will also advance goals associated with capacity, power, and agency that will support iterative, pluralistic approaches to decision-making in fisheries experiencing ongoing climate-driven changes. This process of co-producing knowledge and strategies requires considerable investments of time from all partners, which is well aligned with the Ocean Decade. However, secure funding must be prioritized to support and implement co-production activities over this long time horizon.

Keywords: climate change, co-production, marine fisheries, Ocean Decade, resilience.

Introduction

Sustainable development agendas have highlighted the need for knowledge (i.e. science and other forms of information and data) that not only advances understanding of social-ecological systems, but also identifies solutions that contribute to sustainability outcomes and transformations (Colglazier, 2015; UN General Assembly, 2015; Schneider *et al.*, 2019; Norström *et al.*, 2020). Currently though, there is a large gap between available knowledge and its uptake via societal actions that slows the pace of preparedness and solutions for climate and sustainability challenges. Knowledge co-production has been offered as one approach to reduce this gap and increase application of information to societal issues (Norström *et al.*, 2020). We define knowledge co-production as an iterative, collaborative process of building partnerships that bring together multiple sources and types of knowledge to develop a systems-oriented understanding of a problem and identify potential solutions (adapted from Armitage *et al.*, 2011 and Norström *et al.*, 2020). We adopt the term 'co-production' because it is widely used in the sustainability science literature and encompasses a solution-focused component, although a variety of terms exist for similar transdisciplinary and participatory research approaches (Hakkarainen *et al.*, 2021).

Knowledge co-production is particularly relevant in the context of initiatives focused on the climate-fisheries nexus (Cooke *et al.*, 2021). Local knowledge of the coupled human

and natural elements of fishery systems can contribute real-time, place-based observations of changes at scales that are not easily observed by most periodic scientific surveys (Lima *et al.*, 2017; Ban *et al.*, 2018). Moreover, long-term perspectives gained through experience in a place can support a deep understanding of drivers, patterns, and impacts of these changes. In contrast, scientific data sets and methodologies enable place-based changes to be interpreted within a larger context, and new tools facilitate data sharing and knowledge transfer across systems. Knowledge co-production combines insights from place-based historical perspectives with inference- and model-based methods (Ban *et al.*, 2018; Zurba *et al.*, 2021). Using these jointly can help increase the understanding of change and success of adaptive actions at relevant spatial and temporal scales, which is particularly important as marine ecosystems and fisheries move into states that are outside the bounds of historical analogues (e.g. Gianelli *et al.*, 2021).

As the world strives to achieve development goals in the context of climate change, the UN Decade of Ocean Science for Sustainable Development offers an avenue for scientists and stakeholders to co-produce information and strategies that are necessary to support climate resilient fisheries. The UN Ocean Decade programme, *Fisheries Strategies for Changing Oceans and Resilient Ecosystems by 2030* (FishSCORE), will co-produce knowledge that advances solutions to support

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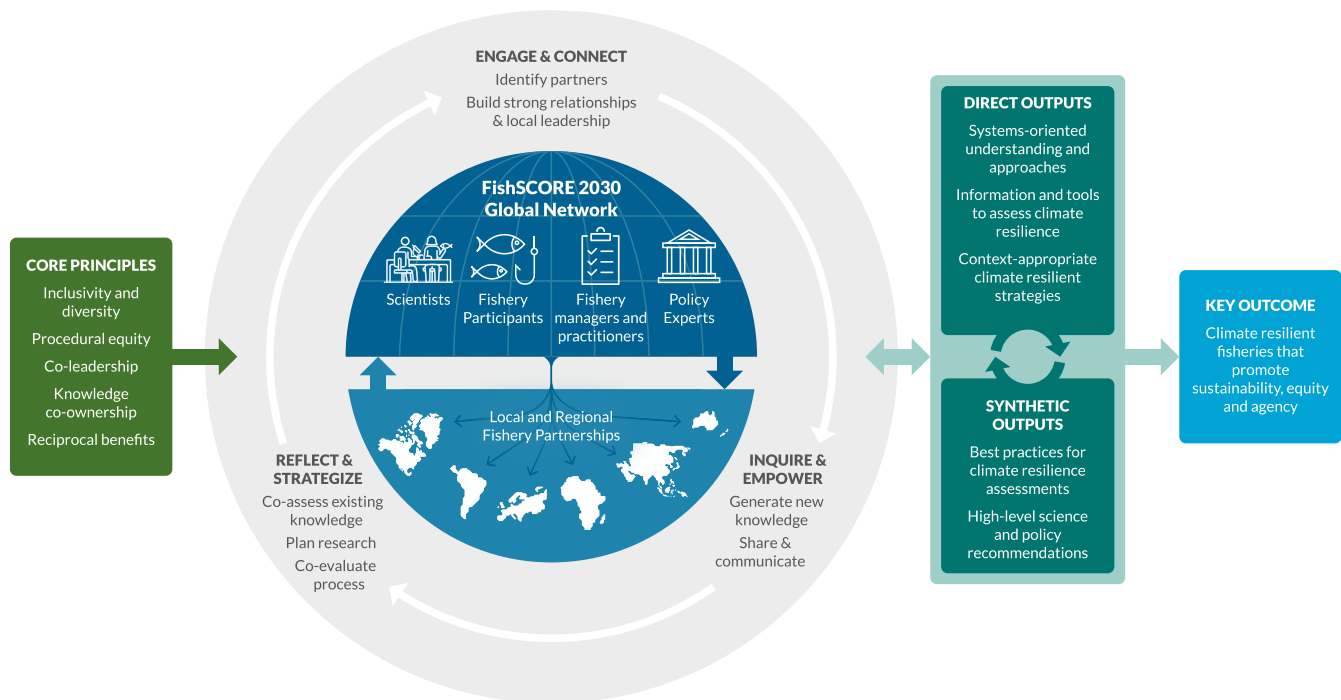


Figure 1. FishSCORE will facilitate synergies between: (1) a global network of diverse collaborators that will develop information and tools to assess climate resilience (blue box) and (2) local and regional partnerships to co-produce knowledge and solutions relevant to specific fisheries (green box). Collaborators and partners will include scientists, fishery participants (including harvesters and supply chain actors), fishery managers, fishery practitioners (including community officials, community development leaders, and non-governmental organizations), and policy experts. Co-production of knowledge and solutions will be grounded in core principles (purple box), a collective leadership model and proposed model of co-production stages (grey arrows; Caviglia-Harris *et al.*, 2021; Cooke *et al.*, 2021). Outputs from FishSCORE will emerge directly from the global network and the fishery partnerships, as well as from syntheses that span these levels (yellow boxes) and will contribute to building climate resilient fisheries that promote sustainability, equity, and agency.

healthy marine ecosystems, sustainable fisheries, and equitable distributions of benefits from a diverse set of global marine fisheries. FishSCORE will establish a network of interdisciplinary scientists, fishery stakeholders, resource managers, community practitioners, and policy makers who will:

- (1) co-produce information and tools to assess climate resilience in diverse fishery systems,
- (2) co-develop approaches and best practices to identify context-appropriate climate resilience strategies, and
- (3) support implementation of solutions to advance climate resilience in marine fisheries.

Through these efforts, FishSCORE will contribute to multiple UN Sustainable Development Goals, including development of healthy marine ecosystems and fisheries (SDG14), improvements in food security (SDG2), poverty reduction (SDG1), and advancements in human health and well-being (SDG3).

Co-production in FishSCORE

FishSCORE will apply collective and transdisciplinary leadership in partnerships between scientists and stakeholders to develop research, information, and strategies related to climate resilience in marine fisheries (Lang *et al.*, 2012; Caviglia-Harris *et al.*, 2021; Cooke *et al.*, 2021; Mason *et al.*, 2022). Although FishSCORE is currently in nascent stages of development, we plan for co-production to occur at two levels with feedback between each level (Figure 1). First, FishSCORE

will establish a global network of scientists and stakeholders representing diverse regional geographies, fishery types, sectoral roles, scientific disciplines, and policy expertise to develop broadly relevant information and tools related to climate resilience in marine fisheries. Second, regional and local fisheries partnerships will be developed in diverse fisheries—from small-scale community-based fisheries to large industrial fisheries embedded within multi-level management structures. In these cases, close collaborations will be established between scientists, policy experts, leaders, managers, and practitioners in the fishery to assess climate resilience, resilience-enhancing strategies will be identified, actionable strategies will be selected, and implementation capacity will be built. FishSCORE's co-production approach will facilitate feedback between these levels to continually improve information and tools, refine practices for applying the tools in specific fisheries, and advance science and policy recommendations that will support climate resilient fisheries.

Core principles supporting effective partnerships will be upheld across all stages and levels of co-production in FishSCORE. These include commitments to inclusivity and co-leadership opportunities for diverse participants, co-ownership of research, and reciprocity of benefits (Cooke *et al.*, 2021, originally from UK National Institute of Health Research 2018). We anticipate issues of agency, power, and equity to arise in all our partnerships and to be particularly acute in situations that involve groups that have traditionally been marginalized (Bennett *et al.*, 2021; Blythe *et al.*, 2021; Fisher *et al.*, 2022). Forefronting these core principles by selecting

partners who can commit to upholding them will foster diverse perspectives, knowledge, and values from participants. However, partners will also need to reflexively hone how the principles are upheld, given the particulars of every situation and how relationships evolve over time. For example, certain voices may need to be elevated to achieve procedural equity (Alexander *et al.*, 2022), and these may change over the duration of the partnership.

Commitments to these principles will also enable multiple modes of co-production directed towards a range of goals in different fishery systems. Chambers *et al.* (2021) identified six modes of co-production—(1) identifying solutions, (2) empowering voices, (3) brokering power, (4) reframing power, (5) navigating differences, and (6) reframing agency. We anticipate co-production partnerships developed through FishSCORE will all have goals related to solutions for climate resilient fisheries. However, these solutions-focused goals may exist in conjunction with others associated with local capacity development, shifting power relationships, and fostering agency in decision-making. Advancing broader goals that develop effective processes for navigating differences and augment power and agency of co-production partners will be increasingly important as climate change continues, given that the ongoing process of change will necessitate iterative re-evaluation and re-invention of solutions.

Our approach in FishSCORE, in terms of the core principles, collective leadership elements, and multiple goals, can be organized as a simplified theory of change (Figure 1), which serves as a benchmark for structuring programme evaluation. FishSCORE will employ both formative and summative evaluations to ensure the FishSCORE network, fishery partnerships, and the programme as a whole are progressing as intended, contributing useful products that improve climate resilience outcomes for fisheries. Participatory evaluation approaches will be used to engage a broad suite of participants in the evaluation process (NIH, 2011; Guijt, 2014). Formative evaluation will be applied to consider adherence to the principles of co-production (e.g. equity) and process of collective leadership in the global network and fishery partnerships, as well as to assess the effectiveness of feedbacks between those two levels. In the formative evaluation, we intend to incorporate opportunities to reflect on the degree to which outputs are aligned with outcomes. The outputs, outcomes, and impacts will be considered during a summative evaluation of each fishery partnership at its conclusion, although FishSCORE aspires to maintain collaborations after solutions are co-produced to ensure they continue to meet expectations (Norström *et al.*, 2020) and remain spatio-temporally relevant to climate stressors. We aim to support and guide participants to revisit solutions to ensure they remain appropriate, meaningful, respectful, and adaptable (Schwarz *et al.*, 2021). Given the anticipated long-term evolution of impacts, we will also evaluate partnerships and the FishSCORE programme as a whole at the end of the Ocean Decade.

Overcoming co-production challenges

Knowledge co-production can advance learning and understanding of a system and build capacities and agency to take action towards solutions (Djenontin and Meadow, 2018; Wyborn *et al.*, 2019). However, there are important challenges that limit the pursuit and effectiveness of co-production efforts, including those associated with historical differences in

social power among stakeholder groups and organizational cultures that privilege particular ways of knowing (Turnhout *et al.*, 2019; Cooke *et al.*, 2021; Reid *et al.*, 2021). Additionally, co-production requires an investment of time that exceeds standard scientific research processes (Cooke *et al.*, 2021). It takes considerable time to identify partners, build trust and establish good working relationships, and carry out an iterative process of applying and advancing information, synthesizing findings, and developing strategies and implementation plans. Investing this time requires resources to support partners over the duration of the collaboration. However, grant funding levels are often not able to provide sufficient time for collaborators within a single grant. Moreover, grant cycles are often short relative to the time needed for iterative science-to-action processes, particularly when outcomes and impacts of those efforts are expected to become apparent over a protracted time horizon that extends well beyond the initial intervention. The time horizon of the Ocean Decade aligns well with co-production needs if programmes can ultimately be funded at levels that support the requisite time investment and ongoing engagement of all partners.

Conclusion

Knowledge co-production offers a key approach for designing effective and equitable pathways to achieve climate resilience in fisheries. The production of knowledge is integral to building governance and management strategies that will remain effective in the face of climate change. Scaling up learnings across systems will provide valuable science and policy directions to underpin climate resilience efforts. FishSCORE will contribute to these advances at local, regional, and global levels, thereby enabling marine fisheries to support sustainable development goals, even as challenges associated with climate change increase in the coming decade and beyond.

Data availability statement

No data were generated or analysed in support of this manuscript.

Author contributions

All authors contributed to the conceptualization and design of the manuscript and co-wrote the original draft and revision, with leadership from KEM.

Conflict of interest statement

The authors have no conflicts of interest to declare.

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