

U.S. Restorative Aquaculture

Realizing Our Farmed Ocean Food Future

Together, we can realize a future where our ocean is healthier because of how we produce food, not despite it.



Policy Brief

Restorative seafood production from aquaculture needs optimism and intervention, 2025, ICES Journal of Marine Science. <https://doi.org/10.1093/icesjms/fsaf223>



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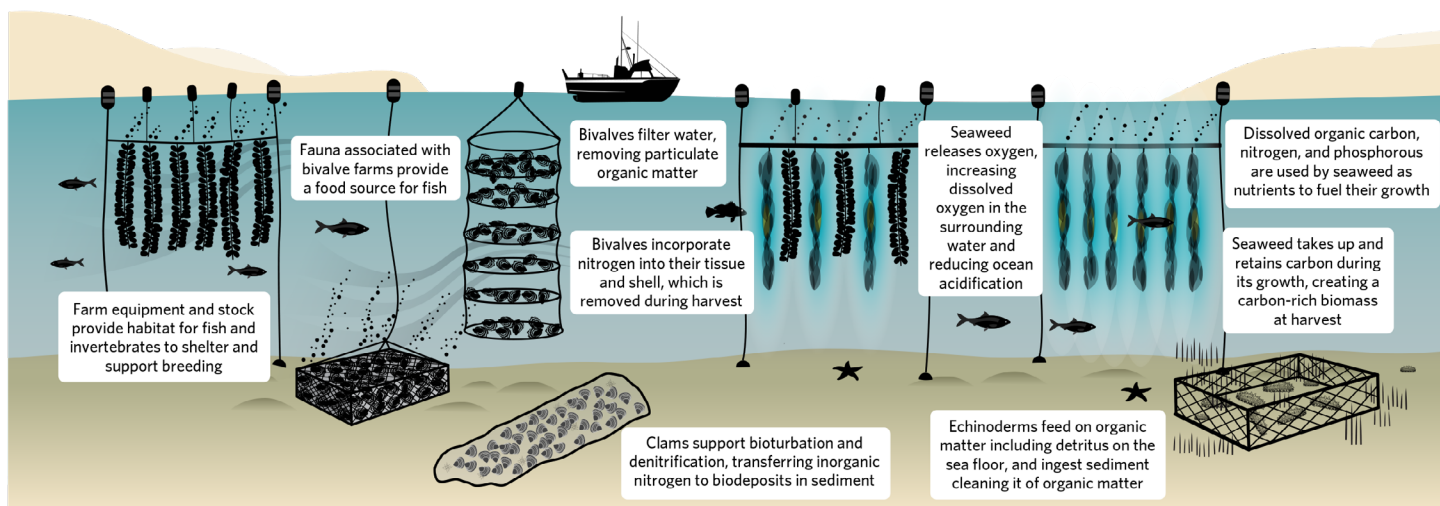
Introduction

Aquaculture represents one of the fastest-growing food production sectors globally. When practiced with nature in mind, it can deliver high-quality protein while also providing social and environmental benefits. The United States has the potential to be a world leader in sustainable seafood production through restorative aquaculture—farming methods that not only minimize environmental impacts but actively improve ocean health and community wellbeing, using practices that:

- Support resilient coastal economies.
- Filter and improve water clarity.
- Remove excess nutrients reducing the pressure of land-based runoff.
- Create habitat for wild marine species.
- Provide climate-friendly protein with minimal inputs.

Less than 10% of total domestic seafood production by weight in the United States currently comes from marine aquaculture.

There are marine aquaculture farms along the Atlantic, Gulf, and Pacific coasts (including Alaska and Hawai'i). Marine aquaculture's footprint is minimal—0.01% of the country's Exclusive Economic Zone—and the demand for sustainable seafood continues to climb.



The Path Forward:

A Vision for 2035

From 2024 to 2025, TNC, in collaboration with industry stakeholders and academic institutions, completed a scenario planning exercise to identify two future states of restorative aquaculture to 2035: a Probable/Business-As-Usual (BAU) and a Preferable-and-Plausible future. Using multiple methods, including an online survey and regional workshops, this research revealed optimism across all stakeholder groups. **More than 84% of aquaculture businesses surveyed indicated a desire to expand in the next five years; 67% of aquaculture businesses said they would likely prioritize restorative practices when expanding.**

However, this research also identified significant constraints that would likely prevent the United States from realizing the full potential of restorative aquaculture, in particular:

- **Regulatory challenges:** 74% of industry respondents cited complex, costly, and time-consuming permitting processes as a significant constraint. Many farmers spend years and considerable resources navigating multiple agencies with overlapping jurisdictions.
- **Public perception:** 74% of respondents identified low social understanding and acceptance of aquaculture as a major barrier, often resulting in opposition to new farms despite potential environmental and social benefits.
- **Limited financial support:** Over half of industry respondents indicated that insufficient access to capital, grants, and investment is a limiting factor for expansion and adoption of restorative practices.
- **Ecosystem service recognition:** The environmental benefits provided by shellfish and seaweed farms—such as water filtration, habitat creation, and carbon cycling—lack formal recognition and compensation in policy frameworks.

Without addressing these barriers, restorative aquaculture in the United States will see only modest, uneven growth by 2035, with continued industry consolidation and limited environmental benefits. But with targeted interventions, we can transition from BAU to a preferred future where:

- **Streamlined, science-based regulations** enable responsible growth with reasonable timeframes and clear pathways for restorative projects.
- **Ecosystem service markets** compensate farmers for their operations' environmental benefits, including water quality improvements, habitat creation, and climate mitigation and adaptation.

Significance of constraints

■ Significant ■ Neutral ■ Not significant ■ Don't know ■ Prefer not to answer

Costs for permitting



Timeframes for permitting



Ongoing regulation



Low social acceptance



Operational constraints



Sufficient finance



Sufficient equipment



Sufficient space



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- **Public-private partnerships** drive innovation in species selection, farming techniques, and monitoring tools to optimize environmental benefits.
- **Community support** grows through education, workforce development, and meaningful engagement with coastal stakeholders, including Tribal and Indigenous communities with traditional knowledge of sustainable ocean farming.

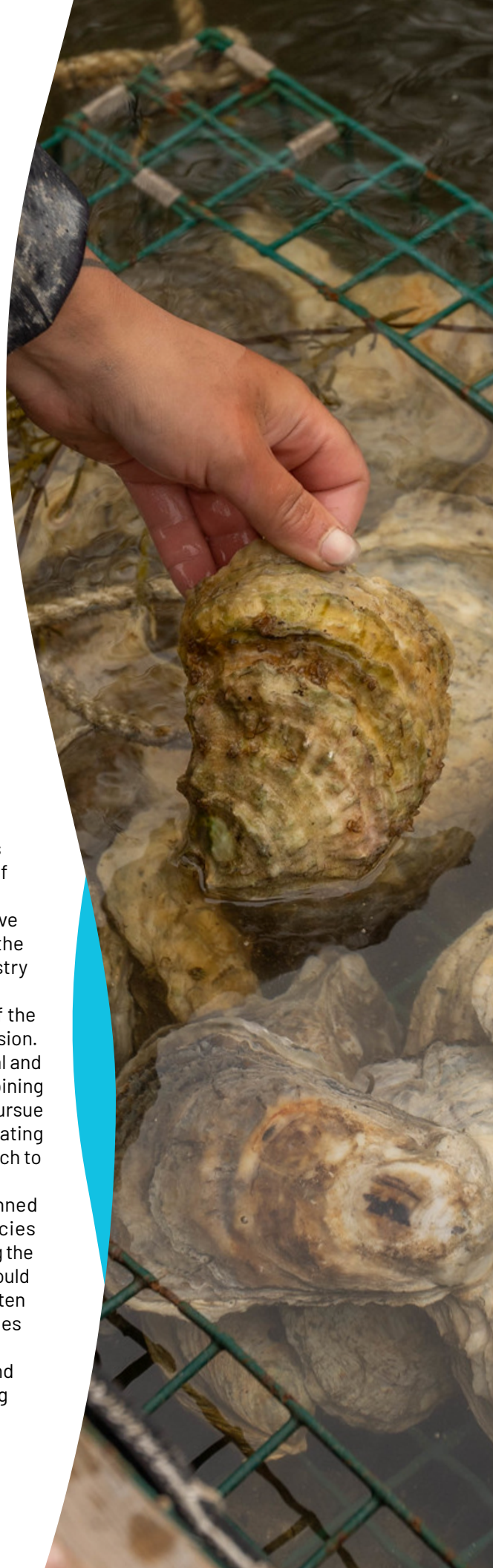
If implemented, these changes could substantially boost restorative aquaculture acreage, production, and benefits by 2035, while supporting thousands of sustainable jobs in coastal communities.

Insights from Stakeholders

A total of 100 unique responses to the restorative aquaculture survey were received. Survey respondents were predominantly from industry (58%), with the remaining participants distributed across academic/research institutions (9%), nonprofit organizations (9%), and various government entities and industry associations, reflecting diverse but industry-centered perspectives represented in the study.

Responses were received from participants in 22 coastal states, predominantly from industry (58% total; 34.7% shellfish aquaculture of all respondents, 9.9% seaweed aquaculture of all respondents), with the remaining participants representing a variety of organizations across academia/research institutions (9%), the nonprofit sector (9%), and other supporting government entities and industry associations, including extensions services (6%), industry associations (6%), federal, state, and local government (10%), and Indigenous community organizations (2%).

- The majority of respondents believe that restorative aquaculture is “likely” or “very likely” to benefit various groups. The habitat restoration community and the scientific community were perceived as the top beneficiaries, with 84% and 91% of respondents respectively viewing them as “likely” or “very likely” to benefit. Other aquaculture operations, coastal residents, and educators and students are also seen as major beneficiaries, with 77%, 83%, and 88% of respondents respectively viewing them as “likely” or “very likely” to benefit.
- Of the industry participants, almost all (90.6%) respondents had lease areas between 0.5–1,700 acres, with more than 40% of respondents actively farming a high proportion of this area (between 90 to 100% of the lease).
- Nearly three-quarters of the surveyed businesses in the industry have been actively pursuing growth and expansion opportunities over the past five years, indicating a dynamic and potentially optimistic industry environment.
- The majority (84.5%, combining “likely” and “very likely” responses) of the surveyed businesses express a positive outlook towards future expansion. This suggests a high level of interest in the industry’s growth potential and the businesses’ capacity to expand. Only a small fraction (10.3%, combining “unlikely” and “very unlikely” responses) indicate they are not likely to pursue expansion, and a smaller portion (5.2%) remain neutral, possibly indicating uncertainty about future market conditions or a wait-and-see approach to expansion.
- Increasing production capacity is the most common form of planned expansion, mentioned by over half of the respondents. Species diversification emerged as the second most common theme, suggesting the potential for a trend towards more varied aquaculture practices. This could be linked to the interest in restorative practices, as diversification often contributes to ecosystem health, but also new business opportunities and increased farm and business resilience.
- The majority of survey respondents (67.3%, combining “very likely” and “likely” responses) expressed a positive attitude towards prioritizing restorative species and practices in their expansion plans.

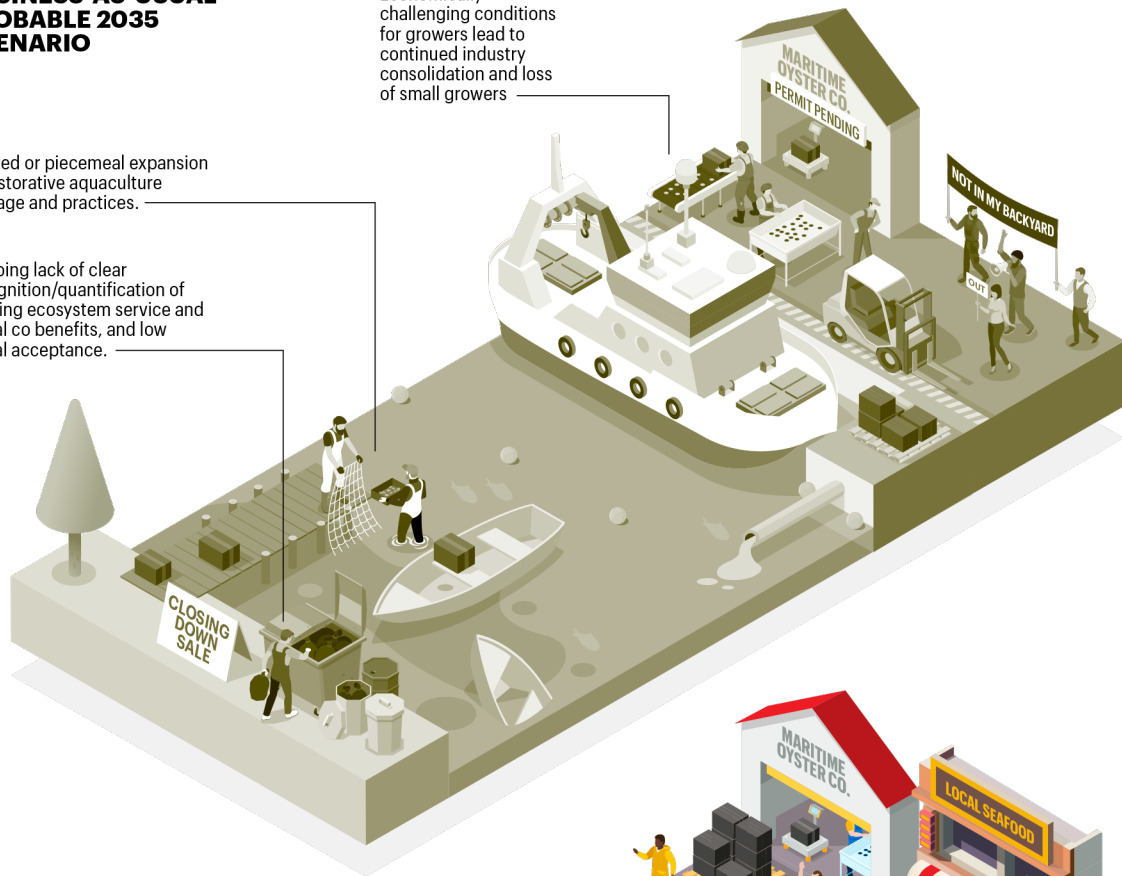


BUSINESS-AS-USUAL PROBABLE 2035 SCENARIO

Limited or piecemeal expansion of restorative aquaculture acreage and practices.

Ongoing lack of clear recognition/quantification of existing ecosystem service and social co benefits, and low social acceptance.

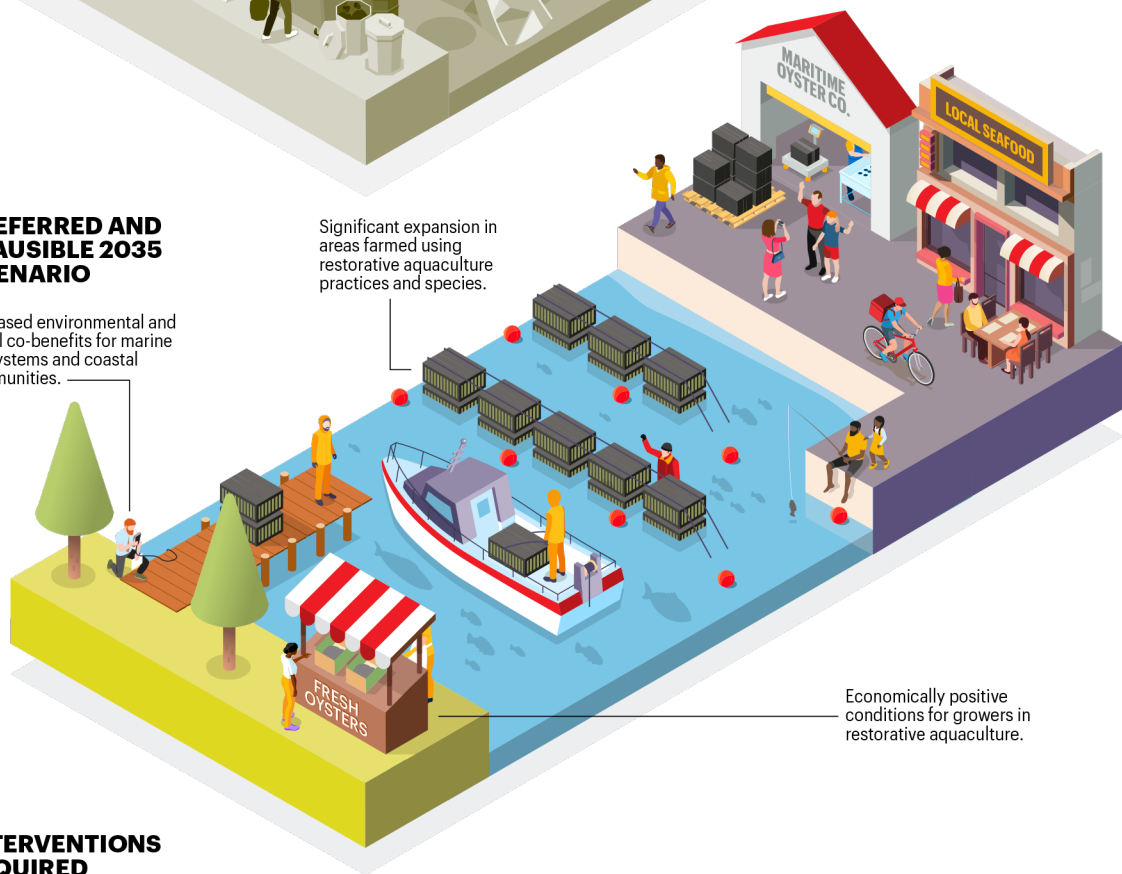
Economically challenging conditions for growers lead to continued industry consolidation and loss of small growers



PREFERRED AND PLAUSIBLE 2035 SCENARIO

Increased environmental and social co-benefits for marine ecosystems and coastal communities.

Significant expansion in areas farmed using restorative aquaculture practices and species.



Economically positive conditions for growers in restorative aquaculture.

INTERVENTIONS REQUIRED



Streamlined, affordable permitting and leasing processes commensurate with risk and appropriate safeguards



Continued grower innovation in species, practices, gear, partnerships, markets



Increased public-private funding for research and development, infrastructure, monitoring



Policy and market incentives such as nitrogen trading credits and ecosystem service payments



Robust science quantifying localized environmental benefits of restorative farms



Expanded consumer and community awareness, appreciation and demand for restorative products



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Emerging and Priority Research Questions

Without substantial changes—that is, under BAU—development and expansion of restorative aquaculture is unlikely to happen as a matter of course. To assist continued exploration of this approach, we identified research questions that could help provide a more comprehensive understanding of the current state and future potential of restorative aquaculture in the United States.

Policy and Management

- What policy changes at the federal, state, and local levels would most effectively support expansion of restorative aquaculture? This could include permitting reforms, funding mechanisms, inclusion in coastal planning frameworks, etc.
- How can Indigenous knowledge and community-based approaches inform the development of restorative aquaculture in culturally appropriate and equitable ways? Engaging underrepresented communities will be important.
- What are the workforce and training needs to enable growth of a restorative aquaculture sector? Assessing current capacity and future labor/skills requirements could inform targeted investments.

Research, Development, and Extension

- What are the most significant operational and ecological knowledge gaps that need to be addressed to scale up restorative aquaculture practices? For example, are there key research needs related to quantifying ecosystem service benefits, developing best practices, identifying suitable sites, etc.?
- How can cross-sector partnerships be leveraged to advance restorative aquaculture goals? Increased collaboration across industry, government agencies, academia, and NGOs could accelerate progress.

Investment and Societal Support

- What supply chain infrastructure is needed to support expansion of key restorative species like shellfish and seaweed? Evaluating gaps in hatcheries, processing facilities, cold storage, distribution networks, etc. will be critical.
- How might integration of restorative aquaculture with other emerging ocean uses, like energy production, impact the scenarios and spatial planning considerations? Assessing co-location potential is increasingly relevant in an increasingly crowded ocean.
- What are the leading candidates for voluntary certification, standards, or eco-labeling to recognize restorative aquaculture products in the marketplace? Appraisal of options could help guide development.

Creating an Enabling Environment

With strategic investments and policy development, the United States can grow an ocean economy that:

- Creates resilient jobs in coastal communities.
- Actively improves ocean health and ecosystem services.
- Reduces America's seafood trade deficit and dependence on imports.
- Produces nutritious protein with minimal environmental impact.

Collaboration and support can help make this vision reality. Through targeted funding for pilot projects, regulatory reform initiatives, public education campaigns, and research, we can accelerate the growth of restorative aquaculture and position the United States as a global leader in sustainable seafood production.

This research confirmed that policy development is critical to growing the restorative aquaculture industry. Good policy can ensure effective regulation without being burdensome, accommodate social preferences for aquaculture and other marine activities, and encourage investment.

Policy options that state and federal governments and supporting organizations in the United States could consider include:

- Establishing and using a **clear definition** of restorative aquaculture in policy and regulations to set a benchmark for nature-positive aquaculture practices.
- **Identifying existing farms or models** that demonstrate restorative practices and support replication.
- Developing databases of **examples of ecosystem services** from aquaculture that can be used:
 - in impact assessments for new lease applications;
 - to answer community questions and concerns when they arise; or,
 - to build the capability of policy makers and supporting organizations to develop approaches that effectively measure ecological and social co-benefits.
- **Developing favorable policy conditions** for restorative farms, such as streamlined, science-based permit changes or lease terms.
- Undertaking **spatial planning processes** or better integrating aquaculture into broader marine spatial planning processes to support the development of restorative aquaculture in locations that will optimize the benefits it can provide, including co-locating aquaculture practices with other uses, such as energy generation.
- Pursuing supportive financing mechanisms such as grants and **ecosystem service crediting** approaches, establishing appropriate methodologies to compensate and encourage farmers.

In addition to these actions, discussions with aquaculture producers, decision makers, and other stakeholders in coastal states could provide further insights on policy barriers and opportunities, while additional engagement with Tribal communities and small-scale fishers/farmers experimenting with restorative practices could highlight Indigenous knowledge and local innovations to build upon.

**The time to invest in the United States' ocean economy is now.
Together, we can transform our coastal waters, growing the
sustainable prosperity that can feed our nation and heal our oceans.**

Acknowledgments

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We are grateful to the survey respondents from the aquaculture industry, government agencies, research institutions, and non-profit organizations for sharing their experiences and perspectives. Their geographical and operational diversity was crucial in building a comprehensive understanding of restorative aquaculture in the United States. We also thank the workshop participants whose insights were essential in developing and refining the future scenarios for restorative aquaculture. The diversity of expertise, cultures, and geographies represented by all contributors—from Indigenous practitioners to innovative farmers, from coastal managers to marine scientists—allowed us to explore restorative aquaculture through ecological, economic, social, and cultural lenses. Collectively, the contributions from all participants have enhanced this study and provided a valuable foundation for actions that could realize the full potential of aquaculture in the United States in years to come.

We thank and acknowledge the Builders Initiative for their ongoing support of restorative aquaculture science that enabled this work to occur.