



# NOAA AQUACULTURE STRATEGIC PLAN (2023-2028)





Our ability to put healthful food on our tables while protecting our global ecosystems has never been more important. As we face the impacts of climate change, paired with a new understanding of the fragility of our food supply chains learned through the COVID-19 pandemic, we must plan for a future that centers around resilience. To ensure resilient ecosystems, coastal communities, seafood access, and more, we must invest in and enable a robust domestic aquaculture industry.

Seafood, both wild and farmed, is vital to our people, economy, and planet. Aquaculture is a key component of our seafood systems and is one of the most climate-friendly and resource-efficient ways to achieve food security, economic, and environmental restoration outcomes. With limited arable land and fresh water to expand terrestrial farming, human populations will increasingly turn to coastal, marine, and Great Lakes resources, and to technologies that efficiently use space, water, and nutrients to source food and reduce climate impacts.

The first of its kind, NOAA's Aquaculture Strategic Plan (2023-2028) lays out a framework to help achieve a robust, thriving, and diverse U.S. aquaculture industry as part of a resilient seafood sector. The NOAA Aquaculture Program developed this plan through a collaborative process that included input from the entire NOAA aquaculture team within NOAA Fisheries, the National Sea Grant College Program, and the National Centers for Coastal and Ocean Science, along with other NOAA offices and programs. Although diversity and inclusion have guided our work since the start, our new plan outlines how we can be more strategic in our actions to address environmental justice and equity within the industry and through management decisions. We sought review and input from our stakeholders through public listening sessions and have incorporated this valuable feedback to ensure the plan reflects the needs of all our stakeholders.

Our continued engagement with diverse stakeholders helped inform this strategic plan, and we will look for ways to work with new and existing partners as we implement this strategy. On behalf of the entire NOAA Aquaculture Program, thank you for your interest in our new Strategic Plan, and your continued support for sustainable aquaculture development in the U.S.



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# NOAA Aquaculture Strategic Plan

The NOAA Aquaculture Strategic Plan at a glance - vision, mission, and strategic goals. This five-year strategic plan (2023-2028) will enable NOAA to expand a resilient aquaculture industry in the United States.

## Our Vision and Mission

**Vision:** A thriving, resilient, and inclusive U.S. aquaculture industry that supports jobs, expands access to nutritious domestic seafood, and reinforces healthy coastal and ocean ecosystems in a changing environment.

**Mission:** To provide science, services, and policies that create conditions for opportunity and growth of sustainable U.S. aquaculture.



### Goal #1

#### Manage Sustainably and Efficiently

Improve regulatory processes for sustainable coastal and marine aquaculture through collaboration with partners.



### Goal #2

#### Lead Science for Sustainability

Use world-class science expertise to meet management and industry needs for a thriving seafood production sector and share this knowledge broadly.



### Goal #3

#### Educate and Exchange Information

Build awareness and support for coastal and marine aquaculture through two-way communication with diverse stakeholders and partners.



### Goal #4

#### Support Economic Viability and Growth

Facilitate a robust aquaculture industry that thrives as a key component of a resilient seafood sector.



Bushels of hard clams harvested and ready for market (Florida). *Credit: Tyler Jones, UF/IFAS.*

## Introduction

### Who We Are

NOAA's aquaculture team, collectively known as the NOAA Aquaculture Program (Program), is composed of expertise in three NOAA Line Offices, each with distinct and complementary roles - NOAA Fisheries (Office of Aquaculture, Regional Offices, and Science Centers, and several headquarters offices and programs), National Ocean Service (primarily the National Centers for Coastal and Ocean Science, NCCOS), and the Office of Oceanic and Atmospheric Research (primarily the National Sea Grant College Program, Sea Grant). We work together to advance sustainable aquaculture development in the United States through [science, service, and stewardship](#).

### What is Aquaculture?

[NOAA's Marine Aquaculture Policy of 2011](#) defines aquaculture as the propagation and rearing of aquatic organisms for any commercial, recreational, or public purpose. This definition covers the production or farming of finfish, shellfish, macroalgae (seaweed), and other aquatic

organisms for: 1) food and other commercial products; 2) wild stock replenishment for commercial, recreational, and subsistence fisheries; 3) rebuilding populations of threatened or endangered species under species recovery and conservation plans; and 4) restoration of coastal, marine and Great Lakes habitat.

Produced responsibly, as it is in the United States, farmed seafood is good for people, good for the economy, and good for the planet. Seafood, wild and farmed, is one of the best sources of nutrients essential for human well-being. Aquaculture is a resource-efficient means to produce protein and helps to improve nutrition and food security and support local economies, in the United States and around the world. As a climate-smart form of food production, aquaculture will be increasingly important as we face a changing climate and uncertain future environmental conditions.

Aquaculture already provides over half of the global seafood supply, and demand for seafood is poised to grow both globally and domestically. Currently, the United States imports at least 70% of its seafood. While we continue to sustainably manage our wild harvest fisheries, we cannot meet the increasing domestic demand for seafood through those fisheries alone. Increasing the sustainable farming of finfish, shellfish, and macroalgae is essential to increase domestic seafood supplies and provide a source of safe, nutritious, and sustainable seafood for consumers in the United States and global marketplace.



North Carolina Sea Grant researcher showcases a farm-raised oyster (North Carolina). *Credit: Baxter Miller*

## About this Plan

This strategic plan is intended to guide the NOAA Aquaculture Program to help achieve a thriving, resilient, and inclusive U.S. aquaculture industry as part of a competitive domestic seafood sector. This plan is intentionally high-level and designed to help align work conducted across the Program, set priorities to achieve our mission, and support NOAA's vision of healthy and resilient ecosystems, communities, and economies. To meet these needs, this plan includes the following key components: a Vision and Mission to guide our work; our Core Values to illustrate who we are as a program and the philosophy behind how we operate; and four overarching goals which, along with our objectives, outline our highest priorities over the next five years to advance sustainable aquaculture development.



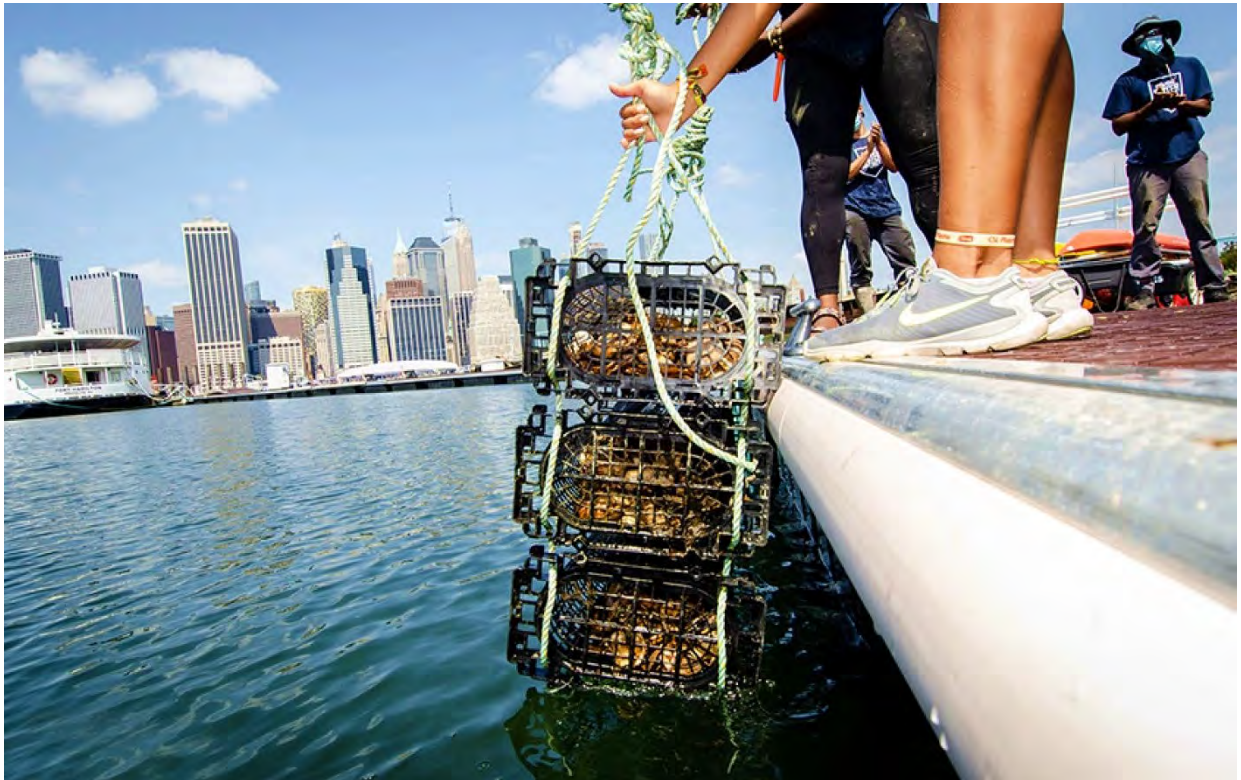
To learn more about what we do go to:

- [NOAA Fisheries Aquaculture](#)
- [NCCOS Aquaculture](#)
- [NOAA Sea Grant Aquaculture](#)

## Vision and Mission

**Vision:** A thriving, resilient, and inclusive U.S. aquaculture industry that supports jobs, expands access to nutritious domestic seafood, and reinforces healthy coastal, marine, and Great Lakes ecosystems in a changing environment.

**Mission:** To provide science, services, and policies that create conditions for opportunity and growth of sustainable U.S. aquaculture.



Students and volunteers monitor young oysters grown as part of the Billion Oyster Project in New York Harbor (New York). *Credit: Steven Dewitt, Witness Tree Media.*

Our core mission is **to provide science, services, and policies that create conditions for opportunity and growth of sustainable U.S. aquaculture.** *Sustainable aquaculture* encompasses the long term “triple bottom line” of economic viability, environmental stewardship, and social responsibility. Improvements in technology and management approaches have made it increasingly possible to grow seafood on land, in coastal waters, and the open ocean in harmony with a healthy and resilient environment. At small and large scales, domestic aquaculture produces food, jobs, and other commercial products for local communities in the U.S. and for the global economy.

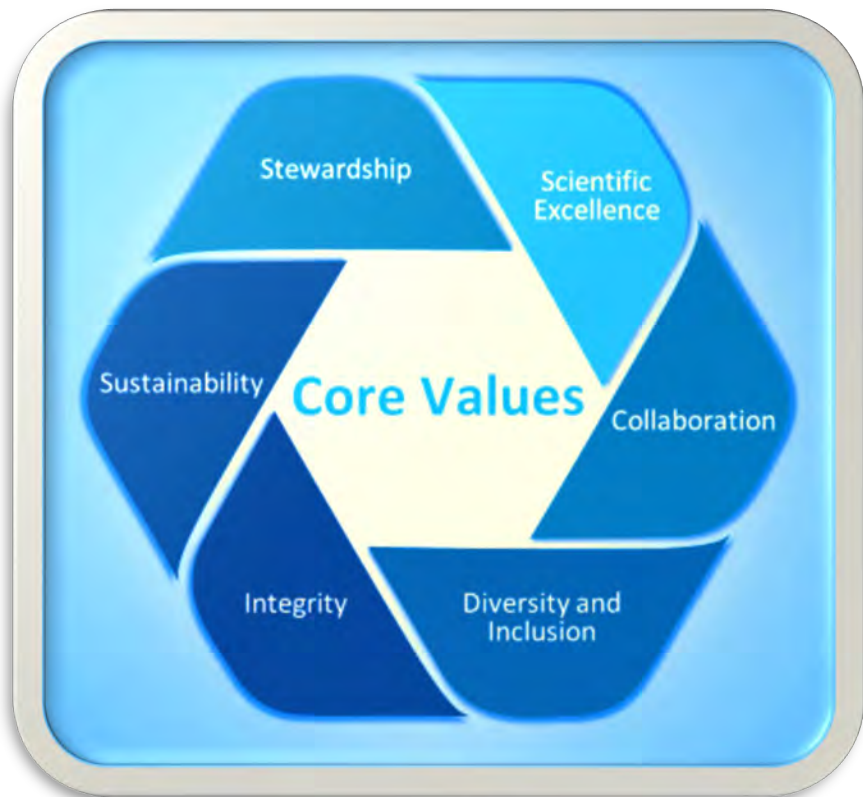
Aquaculture can also be a valuable tool for combating climate change, restoring habitat, replenishing wild stocks, and recovering populations of threatened and endangered species. Our vision statement captures this broad application of U.S. aquaculture and outlines the benefits that could be derived from achieving our mission.

Collectively, our work also helps advance NOAA's overarching vision and mission and the priorities identified by our individual offices. The scope of NOAA's aquaculture activities include providing support for aquaculture for multiple purposes: commercial, recreational, subsistence, and restoration. Advancing aquaculture in these sectors supports the [Department of Commerce Strategic Plan](#), [NOAA's Blue Economy Strategic Plan](#), the [NOAA Fisheries Strategic Plan](#), [NOAA](#) and [Department Of Commerce](#) aquaculture policies, and the developing NOAA Fisheries National Seafood Strategy. In addition, this Aquaculture Strategic Plan aligns with our commitments to implementing the revised National Aquaculture Development Plan and its three thematic Strategic Plans for [Aquaculture Research](#), [Regulatory Efficiency](#), and Economic Development (pending publication) developed by the interagency National Science and Technology Council (NSTC) [Subcommittee on Aquaculture](#) (SCA).

## Core Values

NOAA's Aquaculture Program has identified the following Core Values to illustrate who we are as a program and the philosophy behind how we operate. Through these Core Values we will model exemplary service to the American public:

Figure 1: Core values of the NOAA Aquaculture Program's Strategic Plan: stewardship, scientific excellence, collaboration, diversity and inclusion, integrity and sustainability.







Farmed oysters on Great Cranberry Island are part of a diverse aquaculture industry that has potential to grow (Maine). *Credit: Joseph Conroy III, Maine Aquaculture Association.*

- **Stewardship:** We honor our commitment to the American public as stewards of our shared coastal, marine, and Great Lakes resources.
- **Scientific Excellence:** We employ scientific rigor and innovation to help meet both management and aquaculture industry needs.
- **Collaboration:** We work jointly with a broad coalition of partners to foster sustainable aquaculture development and communicate the value of positive, transparent relationships with our diverse aquaculture community.
- **Diversity and Inclusion:** We recognize the value of and encourage diversity among our team, communities, and partners as part of our ongoing commitment to equity, inclusion, and accessibility.
- **Integrity:** We conduct our work transparently, ethically, and honestly, earning and sustaining the trust of our aquaculture partners and community.
- **Sustainability:** Our effort to successfully support and grow aquaculture encompasses the triple bottom line of economic viability, environmental stewardship, and social responsibility

## Goals and Objectives

To help achieve our Vision and Mission for domestic aquaculture advancement and instill our Core Values in the work we do, we have identified four equally important strategic goals to address: manage sustainably and efficiently, lead science for sustainability, educate and exchange information, and support economic viability and growth. For each goal, we identify the highest priority objectives that the Aquaculture Program will advance in the next five years.

### GOAL 1: MANAGE SUSTAINABLY AND EFFICIENTLY

#### Improve the regulatory processes for sustainable coastal and marine aquaculture through collaboration with partners

The existing regulatory framework for U.S. aquaculture is complex and involves multiple agencies, laws, regulations, and jurisdictions. The issuance of Federal permits and grant funding are “federal actions” that require the Federal agency taking the action to fulfill a variety of statutory requirements, including consulting with other agencies when required. More information can be found in the [Federal Guide to Permitting Marine Aquaculture in the United States \(2022\)](#).

NOAA’s role in improving efficiencies for the federal regulatory framework for aquaculture generally only applies to federal waters outside of state jurisdictions. NOAA’s role supporting aquaculture in state and federal waters varies depending on project specifics and relies on effective coordination with our partners, including Federal and state agencies. Within the context of NOAA’s stewardship responsibilities, this includes protecting the marine and coastal environment and the species it supports while balancing regulatory compliance and multiple uses of ocean spaces. Coastal communities play an essential role in guiding where aquaculture development occurs and informing the science-based regulatory process.



Diver observes Almaco jack (Kampachi) in an offshore net pen operation (Hawai'i). Credit: Jeffrey Milisen.

## NOAA's Points of Engagement in the Permitting Process

### Permits

- Depending on the species proposed for cultivation, a permit from NOAA Fisheries may be required under the Magnuson-Stevens Fishery Conservation and Management Act (MSA).

### National Environmental Policy Act (NEPA) compliance

- Issuing a MSA permit or grant funding requires NOAA Fisheries to comply with NEPA.
- When the U.S. Army Corps of Engineers or the Environmental Protection Agency issues a permit for aquaculture, NOAA Fisheries coordinates with these federal agencies as appropriate.
- For permits for aquaculture projects in Federal waters where an environmental impact statement (EIS) is determined to be appropriate and environmental review or authorization by two or more agencies is required, NOAA may serve as the lead agency.

### Consultations when NOAA Fisheries issues MSA permits or grant funding

- Issuing an MSA permit or grant funding may require consultations with NOAA Fisheries and U.S. Fish and Wildlife Service concerning threatened and endangered species, designated critical habitat, essential fish habitat, marine mammals, and migratory birds under the jurisdiction of the applicable agency.
- Consultation with USDA Animal and Plant Health Inspection Service Veterinary Services is requested for permitted aquaculture operations prior to stocking aquatic animals in coastal and marine federal waters to promote both animal health safety and security.

### Consultations when other Federal agencies issue permits

- NOAA Fisheries consults with the U.S. Army Corps of Engineers and the Environmental Protection Agency on their issuance of permits for aquaculture, as required. This may include consultations for threatened and endangered species, designated critical habitat, essential fish habitat, and marine mammals, as applicable.

### Other regulatory reviews and authorizations

- Depending on the aquaculture project and required regulatory reviews and authorizations may also be required related to aquaculture and ecosystem health, seafood safety and nutrition, protection of maritime navigation, minimizing conflicts with existing uses, and consistency with state and Federal laws.



Kelp harvested in Doyle Bay by Seagrove Kelp Co. (Alaska). *Credit: Jordan Hollarsmith.*



The Nature Conservancy's Supporting Oyster Aquaculture and Restoration (SOAR) Program distributes oysters in the Great Bay Estuary (New Hampshire). *Credit: Jerry and Marcy Monkman, EcoPhotography.*

NOAA coordinates with our federal partners at the national level by co-chairing, with United States Department of Agriculture (USDA) and the White House Office of Science and Technology Policy (OSTP), the interagency NSTC Subcommittee on Aquaculture, and collaborates closely with federal and state agencies regionally. This helps to build an efficient, transparent, and predictable framework of regulations and policies that supports environmentally, socially, and economically sustainable aquaculture.

- **Objective 1A** - Provide expertise to Congress and other stakeholders to resolve issues related to the federal regulatory framework for sustainable aquaculture and for the expansion of federal research and development programs through national legislation or other mechanisms.
- **Objective 1B** - Explore opportunities for more accessible pathways for authorizing small scale or time-limited aquaculture activities (e.g. research, commercial trials, or restoration projects).
- **Objective 1C** - Work with states and federal agencies to execute directives under existing Executive Orders, policies, plans, and statutes to promote sustainable aquaculture as part of NOAA's seafood portfolio (e.g., SCA's [Strategic Plan To Enhance Regulatory Efficiency In Aquaculture](#)).
- **Objective 1D** - Identify Aquaculture Opportunity Areas to support planning for commercial aquaculture development in locations that reduce user conflict, maximize compatible uses, and minimize impacts to public trust resources through scientific analysis and public engagement.
- **Objective 1E** - Provide and use best available science, information, and tools (e.g., siting, water quality and genetics models, peer-reviewed publications) for permit reviews and environmental consultations.

## GOAL 2: LEAD SCIENCE FOR SUSTAINABILITY

Use world-class science expertise to meet management and industry needs for a thriving seafood production sector and share this knowledge broadly

Central to the achievement of our aquaculture vision is to provide leadership for national and international aquaculture science. We will achieve this through funding, conducting, and applying world-class science to address key issues to support the current U.S. aquaculture industry, and to drive its future sustainable development. The NOAA Aquaculture Program engages with diverse partners from across the country and world, including academia, government agencies, tribal governments and organizations, non-governmental organizations, international organizations and industry partners, to prioritize and conduct scientific research that is integral to regulatory, management, and business decisions. We are further guided by the SCA's [National Strategic Plan for Aquaculture Research](#), which represents a shared vision for how federal agencies engaged in aquaculture research can deliver the highest priority, complementary science. Across our aquaculture science products and tools, we aim to thoughtfully integrate knowledge and expertise that reflects the country's diversity. We make our aquaculture science products available to all stakeholders to increase public understanding of aquaculture's environmental, social, and economic implications.



Scientist evaluates a California yellowtail at Hubbs-SeaWorld Research Institute (California).

*Credit: Mark Drawbridge, HSWRI.*

- **Objective 2A - Provide science-based products and tools, including bolstering the translation of research results into advice that supports regulatory and management decision-making.**
- **Objective 2B - Conduct coordinated, applied scientific research to support industry development, including innovations to improve industry success, and efforts focused on restoration aquaculture.**
- **Objective 2C - Strengthen and diversify data collection to support aquaculture industry management and development.**
- **Objective 2D - Confront climate change proactively, identifying threats and leveraging science-based resilience, mitigation, and adaptation opportunities.**

Illustrative examples (not comprehensive) of research underway to address these objectives:

Science for Management	Science for Industry Development	Data Science
<ul style="list-style-type: none"> <li>● Environmental interactions of aquaculture (e.g., habitat, protected species, water quality, ecosystem services)</li> <li>● Spatial analysis and precision siting, including spatial planning for AOAs</li> <li>● Social and economic research to maximize societal benefits</li> <li>● Science advice products to inform NEPA analysis, including for AOAs</li> <li>● Advance seafood safety and aquatic health management practices</li> <li>● Operational forecasts informed by changing weather and ocean conditions (e.g., hypoxia, harmful algal blooms)</li> <li>● Understand climate change effects and identify resilience/mitigation opportunities</li> </ul>	<ul style="list-style-type: none"> <li>● Species breeding, rearing, physiology, and health</li> <li>● Animal nutrition</li> <li>● Extension and cooperative work with industry</li> <li>● Demonstration projects to accelerate aquaculture research and validate performance and reliability for new technology</li> <li>● Market information and resources for business planning</li> <li>● Expand climate resilience/adaptation opportunities (e.g., climate resilient species)</li> <li>● Advanced technology, such as aquaculture gear engineering innovation and recirculating aquaculture systems (RAS) technologies</li> </ul>	<ul style="list-style-type: none"> <li>● Continuously improve national aquaculture production statistics, market value, and other industry data collection and quality</li> <li>● Define and strengthen industry monitoring capabilities</li> <li>● Integrate and apply NOAA’s latest data collection and analysis technologies (e.g., satellites, UxS (uncrewed systems), artificial intelligence)</li> <li>● Incorporate traditional knowledge in our understanding of aquaculture practices</li> <li>● Increase data accessibility for all stakeholders, including for management and industry needs</li> </ul>



NOAA scientist supports growth of aquaculture through extension and outreach (Maryland). *Credit: NOAA.*

### **GOAL 3: EDUCATE AND EXCHANGE INFORMATION**

#### **Build awareness and support for coastal, marine, and Great Lakes aquaculture through two-way communication with diverse stakeholders and partners**

Strong stakeholder relationships, transparent internal and external communication, and outreach activities are critical to the effectiveness of NOAA’s Aquaculture Program. In addition, educating the public about the importance of aquaculture as a sustainable source of domestically produced seafood is important for both the growth of the industry and its acceptance by the public. NOAA has long served a vital role in addressing industry and other stakeholder needs through extension, education, outreach, and technology transfer activities. NOAA will continue to strive to ensure that the needs of all stakeholders are considered, including traditionally underrepresented communities, as domestic aquaculture expands. Providing clear and accurate information about complex, science-based products and processes will not only support the U.S. aquaculture industry, but also facilitate better understanding of the benefits and challenges of aquaculture for a broad and diverse set of stakeholders. Providing ongoing opportunities for input and collaboration is necessary for results that are driven by stakeholders and will support communities, their economies, culture, and the environment.

- **Objective 3A - Seek, listen to, and incorporate stakeholder needs into decision-making by collecting information and feedback on key aquaculture topics using new and existing collaborative relationships.**
- **Objective 3B – Improve perception, social license, awareness and understanding of aquaculture by strengthening communication with the general public, external stakeholders, and within NOAA to enhance awareness of available resources, expertise, and the current state of science regarding coastal, marine, and Great Lakes aquaculture.**
- **Objective 3C – Advance innovative approaches to aquaculture literacy and provide equitable access to education and extension materials. Use these resources to inform the public and other stakeholders on the challenges and benefits of aquaculture and the current state of science and the industry.**
- **Objective 3D - Introduce diverse audiences to aquaculture by incorporating new outreach strategies and widely advertising hands-on educational experiences to engage a variety of stakeholder groups through venues such as public aquaria, aquaculture demonstration facilities, and industry sites.**



University of Wisconsin Stevens Point Northern Aquaculture Demonstration Facility scientists and students showcase salmon grown in a recirculating system (Wisconsin). *Credit: Narayan Mahon.*



## GOAL 4: SUPPORT ECONOMIC VIABILITY AND GROWTH

### Facilitate a robust aquaculture industry that thrives as a key component of a resilient seafood sector

In order to advance domestic aquaculture as part of the Blue Economy, it is imperative that NOAA maintains partnerships with the aquaculture industry, universities, and diverse communities to assess workforce and economic development needs, encourage diverse and inclusive recruitment and business development opportunities, and explore ways to increase operations' resiliency through economic shocks or crises.

Acknowledging the variety of aquaculture systems, species, and business scales that currently exist, NOAA will work

with key stakeholders to understand economic needs and provide appropriate support for prospective and current business operations. Workforce development efforts will address industry needs and provide the necessary training and experience in various skills for employees to successfully enter and contribute to the aquaculture industry. NOAA will work with partners to support access to funding and economic development opportunities more broadly across the aquaculture community, including access to new technologies, equipment, and infrastructure that are needed to advance the industry. NOAA will also support the development of business tools, including business planning and market strategies, to aid in industry success.



Research supported by NOAA Sea Grant through the StriperHub initiative is assisting in the commercial development of striped bass and hybrid striped bass aquaculture. *Credit: North Carolina State University.*

- **Objective 4A - Support workforce development, with a commitment to diversity, inclusion, and accessibility, based on local communities' needs, interests, and capacities. This may include expanding public-private partnerships and associated accessible training programs and apprenticeships, or stakeholder-based internships to provide relevant skills to support industry.**
- **Objective 4B - Connect aquaculture producers, including small and medium enterprises, with federal and state government programs to enhance access to capital, equitable lending and insurance programs, extension and grants for research and development.**
- **Objective 4C - Work internally to attract, recruit, hire, and retain talented and diverse employees, and promote efforts for similar practices to be followed by the aquaculture industry.**
- **Objective 4D - Explore innovative approaches for fostering growth of early stage aquaculture companies, new technologies for aquaculture production, and development of new products and customers (e.g., innovation incubators or accelerator programs).**



Oysters grown in cages in Westmouth Bay off Harkers Island (North Carolina). *Credit: Baxter Miller.*



Oyster farmer tends cages (South Carolina).  
Credit. South Carolina Sea Grant Consortium.

## Looking Forward

The U.S. has substantial untapped potential to increase aquaculture production. In implementing this Strategic Plan, NOAA is working to build a more agile aquaculture program that is responsive to emerging needs and the priorities of industry, coastal communities, and other stakeholders.

As outlined in the goals of this plan, innovation through aquaculture provides a suite of options that can grow and adapt our nation's seafood production to ensure environmental sustainability, food security, and economic benefits. Globally, aquaculture is growing rapidly, and we will take the opportunity to learn from and collaborate with international partners to benefit from best practices and lessons learned, and to build a technologically advanced industry in the U.S.

Sustainable aquaculture is increasingly recognized internationally as a climate-smart form of food production that can be embraced as part of a comprehensive climate strategy.

Aquaculture development can also help diversify and strengthen coastal economies and support and maintain working waterfronts in the face of changing climate conditions and competing priorities for waterfront property and infrastructure. The aquaculture sector can provide new coastal and marine resource dependent jobs, especially in those areas affected by declining fishing opportunities as fish stocks change from their historic habitats and migration patterns.

To have a truly sustainable, climate-smart aquaculture industry within the United States, we need to bring diversity, inclusion, equity, and accessibility to the forefront of our work in implementing this plan. As the U.S. aquaculture industry continues to expand, we have the opportunity to build a sector that reflects the public we serve, while improving access to cost-effective sustainable seafood, better community health, and enhanced climate resilience. We will strive to learn from indigenous knowledge and aquaculture practices, facilitate discussions with underrepresented communities, and apply the lessons learned from the pandemic to our future work.

As the economic, environmental, and social dimensions of aquaculture evolve, the NOAA Aquaculture Program will be responsive in how we implement this plan and adapt to the current needs of our stakeholders. We will work with the aquaculture community to listen, learn, and achieve meaningful outcomes together.

Cover (pics listed top to bottom, then left to right)

Backdrop (kelp): Bull kelp in the current (California). *Credit: California Sea Grant.*

Pic 1: Almaco jack (Kampachi) swimming circles in a cage (Hawai'i). *Credit: Jeffrey Milisen.*

Pic 2: An oyster farm in Tomales Bay (California). Ulva seaweed growing on cages provides habitat and ecosystem services. *Credit: Marc Dewey.*

Pic 3: Alakoko Pond Fish Farm (Hawai'i). *Credit: Tori Spence, NOAA.*

Pic 4: Kelp farm in Doyle Bay (Alaska). *Credit: Seagrove Kelp Co.*

Pic 5: Student deploying oyster cages as part of a North Carolina Sea Grant research project (North Carolina). *Credit: Baxter Miller.*

Pic 6: Net pen finfish aquaculture (Hawai'i). *Credit: Blue Ocean Mariculture.*

Pic 7: Oysters grown on Kualoa Ranch (Hawai'i). *Credit: Tori Spence, NOAA.*

Pic 8: Mussel longlines (New Zealand). *Credit: Darryl Torckler.*

Pic 9: Hard clams harvested and ready for market (Florida). *Credit: Amy Stuart, UF/IFAS.*

Pic 10: Oyster farmer emptying bags (Connecticut). *Credit: Connecticut Sea Grant.*

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Research and innovation have improved the way kelp is cultivated offshore (California). *Credit: Ocean Rainforest.*