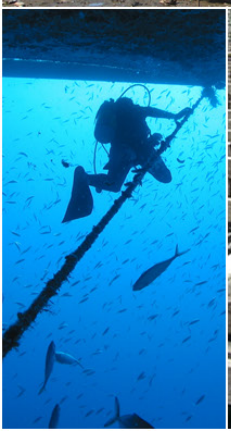
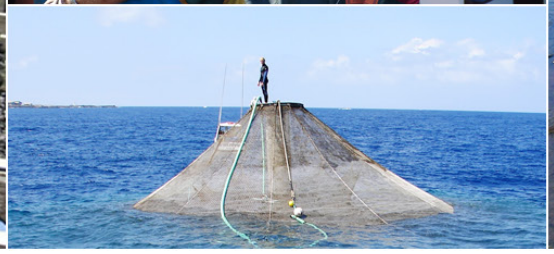
NOAA FISHERIES

Marine Aquaculture

Strategic Plan

FY 2016-2020


Aquaculture provides valuable resources to people here in the United States and globally, and it will continue to grow well into the future. Together, we need to develop a strategy to increase production in U.S. waters and increase public awareness of its importance to our sustainable seafood portfolio.

Dr. Kathryn Sullivan

NOAA Administrator

Seaweb Seafood Summit

February 2015

Marine Aquaculture

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FY 2016-2020

U.S. DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Office of Aquaculture

NOAA FISHERIES

Contents

Preface

Marine aquaculture enhances coastal resiliency, creates jobs, improves food security and human nutrition and is a valuable tool to help rebuild some protected species and habitats. Limits to wild fisheries, environmental changes, the nutritional benefits of seafood, and trends in global seafood markets underscore the need to increase U.S. marine aquaculture production and to selectively use aquaculture to help restore species and habitats.

We have made significant progress in achieving our aquaculture mission since the adoption of our last strategic plan, the 2007 NOAA 10-Year Plan for Marine Aquaculture. With the support of our partners, NOAA has helped improve the federal regulatory process for aquaculture, developed key products that serve the scientific needs of management and industry, and now lists aquaculture as an agency priority. These efforts helped spark recent growth in U.S. marine aquaculture production.

In this 5-year Strategic Plan, we take a fresh look at our priorities and address the regulatory, scientific, technical, communications, and organizational needs to advance U.S. marine aquaculture. This Plan will help ensure that NOAA is focused on critical aquaculture priorities to ensure an efficient and strategic use of limited resources.

This Plan is intended to guide strategic actions within NOAA Fisheries but incorporates key activities undertaken by our NOAA partners at the National Ocean Service (NOS) and the Office of Oceanic and Atmospheric Research (OAR). While cognizant of limited resources, this Plan aspires to drive results and to help us reach our full potential.

The Office of Aquaculture developed this Plan over several months through a collaborative process that included input from the entire NOAA aquaculture team and other NOAA Fisheries offices and science centers. We sought review and input from our stakeholders through a public comment period, including the Marine Fisheries Advisory Committee (MAFAC) Aquaculture Task Force. We have incorporated this valuable feedback to ensure this Plan reflects the needs of our stakeholders.

It took teamwork and advice from scientists, producers, nongovernmental organizations, and government agencies to produce this Plan, and it will take the same to fulfill the challenging mission that we have laid out. By working together, we can ensure that U.S. marine aquaculture grows to provide significant environmental, social, and economic benefits to the American public.

Dr. Michael Rubino
Director
Office of Aquaculture

Setting the Stage: Opportunities and Challenges

Aquaculture in a global context

The global human population is rising, but the global abundance of wild fish is not. Wild fish harvests have been flat for the past 30 years. Seafood plays an important role in global food supply and security. About 3 billion people rely on seafood as one of their primary sources of animal protein. Ensuring that seafood supply can keep up with increased demand from population growth and shifting demographics is vitally important.

According to the United Nations Food and Agriculture Organization (FAO), "with capture fisheries production stagnating, major increases in fish food production are forecast to come from aquaculture….[A]n additional 27 million metric tons of production will be needed to maintain the present level of per capita consumption in 2030" (FAO 2012). This increased demand is driven in part by population growth but also by emerging middle classes in China, India, and Brazil, and accompanying shifts in food preferences toward seafood.

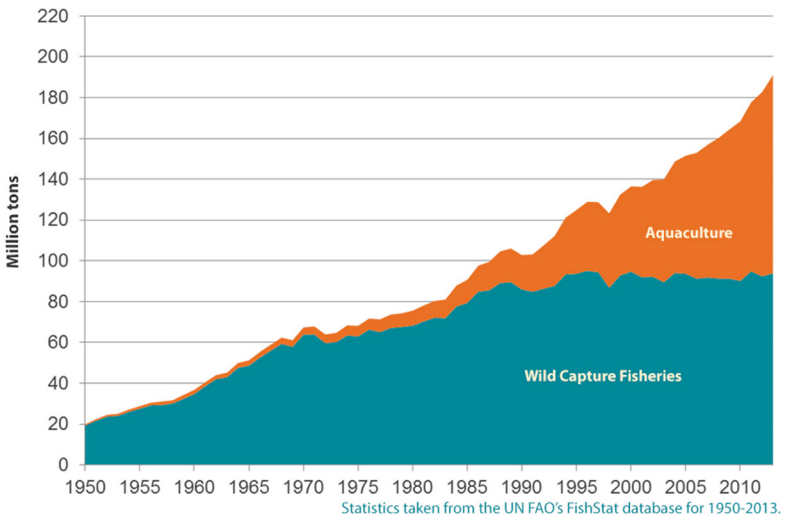
The FAO estimates that, globally, 29 percent of stocks are fished at biologically unsustainable levels. Some great efforts have been made to address the overfishing problem, and incremental progress has been made at a global scale. But even with such improvements, wild capture fisheries will not meet the demand for seafood.

Aquaculture is well placed to help fulfill the demand. In many parts of the world, aquaculture has already helped improve nutrition and food security. Aquaculture production reached an all-time high of 97 million metric tons in 2013 and is the fastest growing form of food production, at 6 percent per year globally (FAO 2014).

What is Aquaculture?

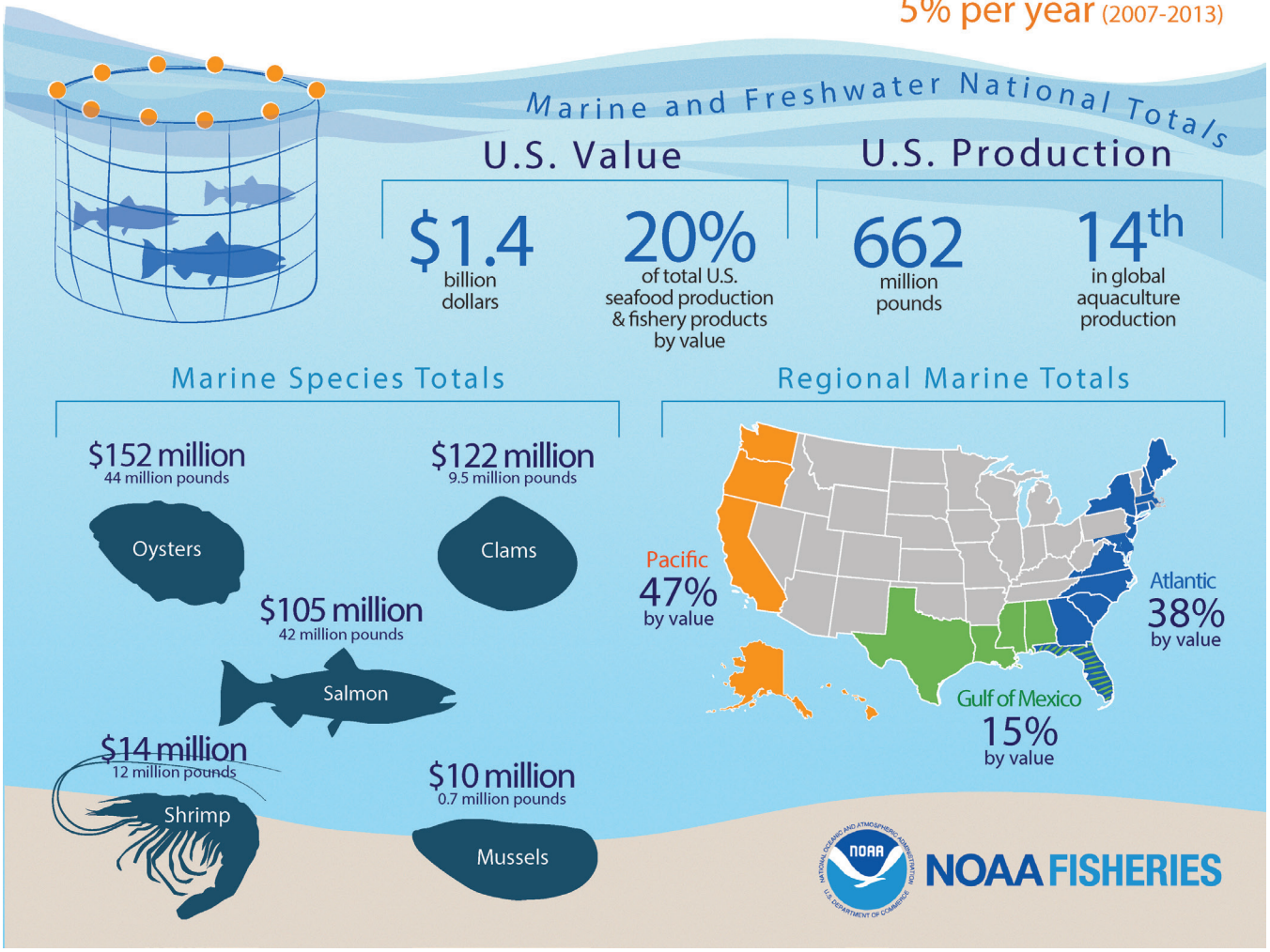
NOAA's Aquaculture Policy of 2011 defines aquaculture as the propagation and rearing of aquatic organisms for any commercial, recreational, or public purpose.

Global Seafood Production



Statistics taken from the UN FAO's FishStat database for 1950-2013.

U.S. marine aquaculture is growing
5% per year (2007-2013)



The potential and need for the growth and diversification of marine aquaculture globally is significant. Our oceans cover over 70 percent of the Earth's surface but currently account for only 2 percent of human food (Duarte and others 2009). Marine aquaculture is lagging behind in development compared to its freshwater counterpart, accounting for less than 50 percent of global aquaculture production, with marine finfish accounting for only about 7 percent (FAO 2015).[1]

The importance of marine aquaculture in the United States

The United States is one of the largest markets for seafood in the world. Despite possessing the world's largest Exclusive Economic Zone, the United States imports approximately 90 percent of the seafood consumed domestically by value. Even if all U.S. fisheries exports were consumed domestically, the United States would still remain approximately 1 million metric tons short of fulfilling current domestic demand for seafood. With a rising seafood trade deficit of more than $14 billion, this reliance on imports moves potential seafood jobs overseas and poses a risk to our nation's food security (NMFS 2015).

> "Aquaculture is a bright spot and one that we need to continue to nurture, both for the food supply that it provides and for the fact that it provides year-round, living wage jobs centered in coastal and rural communities… Let's start using more U.S.-developed technology and expertise here to help pave the way for a more robust industry in the United States."
>
> Dr. Kathryn Sullivan, NOAA Administrator,
> Seaweb Seafood Summit,
> New Orleans 2015

[1] "Marine finfish" includes diadromous fishes (i.e., Atlantic salmon).

Seafood contains nutrients essential for human health. Numerous scientific studies link seafood consumption to a multitude of health benefits, including a reduced risk of coronary heart disease death and total mortality (Mozaffarian and Rimm 2006). The U.S. federal nutrition guidelines (USDA and FDA 2011) affirm that Americans should significantly increase their seafood consumption from the current level of one meal a week.

Congress recognized the importance of domestic aquaculture in meeting the future food needs of the United States when enacting the National Aquaculture Act of 1980. The Act declares that it is in the "national interest and national policy to encourage aquaculture development in the United States" and has charged federal agencies including NOAA[2] to carry out this charge.

Currently, the United States produces a relatively small amount of its seafood from aquaculture—only $1.4 billion, weighing approximately 300,000 metric tons (661 million pounds) in 2013. Domestic aquaculture only makes up about 6 percent of total U.S. seafood production by volume and 20 percent by value. The U.S. marine aquaculture sector produced $403 million worth of seafood weighing approximately 49,000 metric tons (108 million pounds) and is significantly smaller than the U.S. freshwater sector. While U.S. freshwater production has declined in recent years, U.S. marine aquaculture production has been increasing at a rate of 5 percent a year on average for the 5-year period ending in 2013 (NMFS 2015).

Despite its small size, regionally U.S. marine aquaculture is important. In many fishing and coastal communities, aquaculture creates jobs and supports other sectors such as seafood processing, feed and equipment manufacturing, and food services. For example, in the Northeast (Maine through Virginia), the landed value of aquaculture products was $219 million in 2013—the third largest value of any seafood category landed in the region, eclipsed only by scallops and lobsters. By comparison, all groundfish landings in the Northeast combined were valued at only $61 million in the same year. Much of the growth in aquaculture in the Northeast comes from oyster farms in Virginia and salmon farms in Maine. Many other states, including Massachusetts, Rhode Island, Maryland, and Virginia, are reporting all-time highs in shellfish aquaculture production. On the West Coast, aquaculture continues to make strong contributions to the coastal economy. The aquaculture industry in the State of Washington now includes more than 100 farms producing more than $200 million worth of seafood annually (USDA 2014).

In addition to opportunities to expand aquaculture in coastal waters, high potential exists for marine aquaculture in the United States in various sectors, including moving aquaculture offshore. A recent study by the Food and Agriculture

Did you know?

The world's total present agricultural output could be matched by seaweed production in area covering only 0.74% of the world's oceans (Forester, 2011).

[2] Via the Department of Commerce

Organization of the United Nations (FAO) concluded that the United States is the country with the greatest potential for offshore aquaculture when considering environmental and economic factors (Kapetsky and others 2013). NOAA Fisheries has been involved in regulatory, science, and technology development offshore aquaculture. In 2014, federal agencies issued the first experimental permits for mussel aquaculture in federal waters in New England and California using submerged longlines. Several new permit applications have been received by federal agencies for aquaculture projects in federal waters off California. Federal waters will be open to commercial-scale finfish farming in the Gulf of Mexico now that the regulation to implement the Gulf of Mexico Fishery Management Plan for Offshore Aquaculture is finalized.

Other emerging opportunities include growing seafood in land-based tanks and developing seaweed aquaculture. New businesses across the United States are emerging to cultivate marine species in land-based systems, including finfish and marine shrimp. Seaweed also has high potential for commercial development in the United States as a fast-growing crop that yields high market prices and can have positive effects on the marine environment (i.e., absorbing nutrients), but U.S. production remains low. NOAA Fisheries has encouraged science and technology development for both land-based systems and seaweed aquaculture in recent years through grants and in-house research.

NOAA defines aquaculture to include aquaculture for any purpose: commercial, recreational, and public. Aquaculture techniques can provide valuable tools for managers to help recover threatened and endangered species when recommended in an approved recovery plan or when determined to be necessary to prevent extinction of a species. Aquaculture is used to prevent the extinction of several species that NOAA Fisheries has identified as being at high risk of extinction, including endangered abalone, some Pacific salmon stocks, and Atlantic salmon. Aquaculture is also used for habitat restoration and for stock enhancement of commercially and recreationally important species. Shellfish hatcheries are currently being used for oyster restoration efforts in the Chesapeake Bay, Puget Sound, and elsewhere. Large-scale stock enhancement efforts occur for Pacific salmon on the West Coast, while smaller stock enhancement efforts exist in the Southeast for red drum and spotted sea trout.[3]

NOAA Fisheries and its partners have made good progress in ending overfishing in the United States through sound, science-based management practices, while ensuring seafood production and maintaining economic opportunities. However, these efforts alone will not significantly increase U.S. seafood production. The full potential for U.S. aquaculture has yet to be realized, and U.S. interests are missing out on significant business and trade opportunities. While U.S. marine aquaculture has grown in recent years, much more is required if the United States is to achieve its potential as a significant aquaculture-producing nation.

This Plan will guide NOAA Fisheries' strategic contributions to sustainable marine aquaculture development in the United States. This Plan was informed by and builds upon the NOAA and Department of Commerce Aquaculture Policies of 2011 and the National Ocean Policy Implementation Plan of 2013. This Plan lays out an ambitious strategic framework for the next 5 years, while remaining realistic about what can be achieved in the current era of limited budgets and resources.[4]

[3] While protected resources, habitat restoration, and stock enhancement are areas primarily overseen by other offices within NOAA, the Office of Aquaculture supports these activities.

[4] Aquaculture accounts for less than 1 percent of NOAA Fisheries' Budget.

Vision and Mission

Vision: A robust U.S. marine aquaculture sector that creates jobs, provides sustainable seafood, and supports healthy oceans

Mission: To provide science, services, and policies to support the significant expansion and sustainability of U.S. marine aquaculture

Our marine aquaculture vision and mission advance those of NOAA and support NOAA Fisheries' priorities. Central to our aquaculture mission is ensuring that U.S. marine aquaculture grows sustainably. We define sustainable aquaculture to encompass the "triple bottom line" of environmental, economic, and social sustainability.

Marine aquaculture is part of the agency's strategy for economic and environmental resiliency in coastal communities and supporting healthy oceans. Marine aquaculture operations provide a year-round source of high-quality jobs and economic opportunities in coastal communities that augment seasonal tourism and commercial fishing. Marine aquaculture is also a resource-efficient method of increasing and diversifying U.S. seafood production that can expand and stabilize U.S. seafood supply in the face of environmental change and economic uncertainty. Some marine aquaculture, such as shellfish and seaweed aquaculture, provides environmental benefits by removing excess nutrients from our waterways. Aquaculture is also used for species and habitat restoration, and is part of a strategy to recover NOAA priority species.

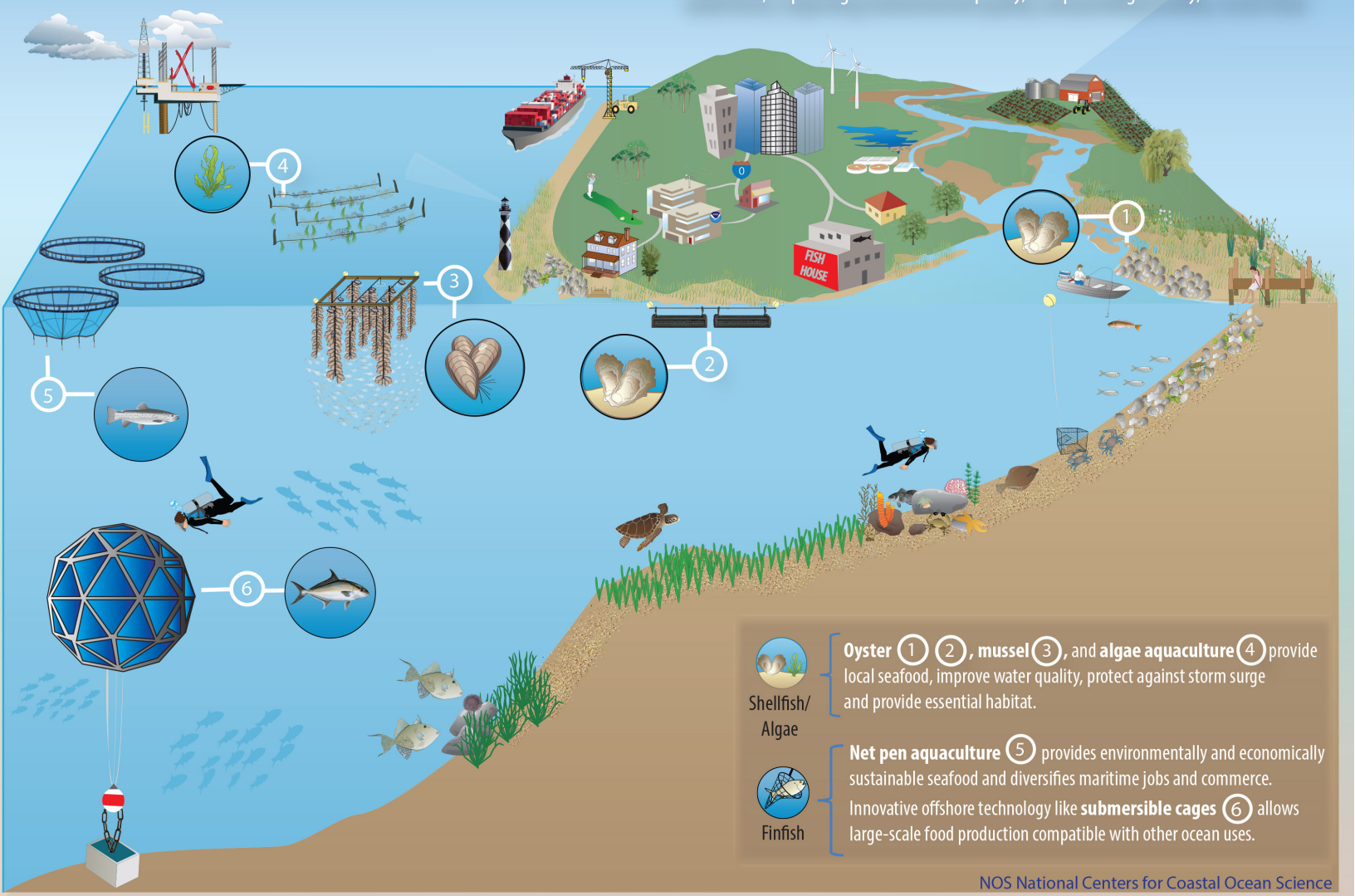
NOAA's Vision:
Resilient Ecosystems, Communities, and Economies

NOAA's Mission:
Science, Service, and Stewardship

NOAA Fisheries' Priorities:
- Ensure the productivity and sustainability of fisheries (including aquaculture) and fishing communities through science based decision-making and compliance with regulations.
- Recover and conserve protected resources through the use of sound natural and social sciences.
- Improve Organizational Excellence

AQUACULTURE GROWS RESILIENT COASTAL COMMUNITIES

Marine aquaculture builds resilient coastal communities by growing working waterfronts, improving environmental quality, and providing healthy, secure food.



Shellfish/ Algae

Oyster (1) (2), **mussel** (3), and **algae aquaculture** (4) provide local seafood, improve water quality, protect against storm surge and provide essential habitat.

Finfish

Net pen aquaculture (5) provides environmentally and economically sustainable seafood and diversifies maritime jobs and commerce.

Innovative offshore technology like **submersible cages** (6) allows large-scale food production compatible with other ocean uses.

NOS National Centers for Coastal Ocean Science
Coastal Aquaculture Planning and Environmental Sustainability Program

New Emphasis on Aquaculture in NOAA Fisheries FY 2016 Priorities and Annual Guidance:

For the first time, NOAA Fisheries highlights marine aquaculture's contribution to seafood security in the FY 2016 Priorities and Annual Guidance document. The document prioritizes efforts to "significantly increase the supply of domestic seafood through science-based development of U.S. marine aquaculture and a holistic understanding between aquaculture and the marine environment."

Evaluating Our Impact

Expand sustainable U.S. marine aquaculture production by volume by at least 50 percent by the year 2020

U.S. marine aquaculture production increased 5 percent annually by volume over the 5-year period 2008–2013. NOAA and its partners have contributed to this increase. If we work effectively with our partners to implement this Plan, we will have a positive impact on the future growth of the marine aquaculture sector. To drive our activities and evaluate our impact, we established the above target for a 50 percent increase in U.S. sustainable marine aquaculture production over the next 5 years, which equates to an annual growth rate of approximately 8 percent.

To achieve this target, we will focus on four strategic goals: regulatory efficiency, tools for sustainable management, technology development and transfer, and an informed public. Within each goal, we identify several objectives and the strategies to achieve them. Following a discussion of each goal, we identify several cross-cutting strategies critical to achieving our aquaculture mission.[5]

[5] The targeted 5-year increase of 50 percent and equivalent 8 percent annualized rate reflects the growth rate of the U.S. marine aquaculture industry during the 5-year period 2007–2012 . Progress will be measured based on data available in Fisheries of the United States 2016 and 2020 editions. This metric and target were selected based upon a full range of factors, including relevance to our mission and vision, our resources, and available data. Other metrics, such as the number of U.S. aquaculture farms or permits issued, may be used to measure NOAA Fisheries' progress in achieving our aquaculture mission.

Goal 1: Regulatory Efficiency

Develop coordinated, consistent, and efficient regulatory processes for the marine aquaculture sector

The regulation of U.S. commercial marine aquaculture is complex, involving multiple agencies, laws, regulations, and jurisdictions. As a result, permitting processes can be time-consuming and difficult to navigate, significantly limiting access to sites.

We will work collaboratively to increase regulatory efficiency in both state and federal waters, while maintaining the agency's environmental conservation and management responsibilities. Success will depend upon effective leadership and collaboration with other NOAA programs, federal agencies,[6] state and local agencies, and tribal groups. Each of these partners plays a substantial role in the regulation of commercial marine aquaculture.[7]

In addition to NOAA's specific regulatory responsibilities (see sidebar), the National Aquaculture Act of 1980 directs NOAA[8] "to provide for the development of aquaculture in the United States." In order to achieve this charge, NOAA Fisheries must play a lead role as a convener, coordinator, and science provider to facilitate permitting and regulatory processes in marine waters nationwide.

NOAA's Regulatory Responsibilities for Marine Aquaculture

In federal waters NOAA Fisheries is taking on new and direct permitting responsibilities under federal fisheries management law. As regional fishery management councils develop aquaculture Fishery Management Plans (FMPs), NOAA Fisheries will develop regulations, issue permits, and conduct the necessary consultations to ensure essential fish habitats and protected species are adequately protected.

In state and federal waters where no applicable FMP is in place, NOAA Fisheries' role is still important. While NOAA Fisheries does not issue permits in such cases, the agency consults with partner permitting agencies (e.g., the U.S. Army Corps of Engineers and the Environmental Protection Agency) on habitat and protected species matters.

[6] Federal coordination efforts are implemented at the national level through the Interagency Working Group on Aquaculture, which operates under the Life Sciences Subcommittee of the Committee on Science of the National Science and Technology Council. (See Appendix 1)

[7] NOAA Fisheries works closely with other federal partners on marine aquaculture regulation, including the U.S. Army Corps of Engineers, the Environmental Protection Agency, the Food and Drug Administration, and the U.S. Department of Agriculture. We also work with state, local, and tribal agencies that have additional regulatory requirements in coastal waters. For detailed information on aquaculture permitting, visit the NOAA Fisheries Aquaculture website at: http://www.nmfs.noaa.gov/aquaculture/policy/24_regulating_aquaculture.html

[8] Via the Department of Commerce

Goal 1: Regulatory Efficiency

Objectives	Strategies
Improve existing permitting processes for marine aquaculture in state and federal waters	Address barriers identified by stakeholders and work with permitting agencies and Congress toward regulatory and legal solutions
	Proactively work with federal, state, local tribal agencies and other governing bodies to implement effective permitting and management processes in state and federal waters, while maintaining environmental conservation and management responsibilities: • Identify and consolidate redundant processes • Clarify agency roles and responsibilities • Build consensus on regulatory and permitting decisions
	Encourage and ensure greater use of general permits, regional or bay-wide approaches, and programmatic documents in situations where evidence indicates they are likely to be effective
	Work with permitting agencies to develop user-friendly and service-oriented permit application processes: • Encourage the practice of pre-consultation meetings • Provide easily accessible and up-to-date information to prospective applicants, including guidance documents and relevant science information • Consult with and assist permit applicants as they prepare applications
	Work with states and regional partners to develop additional state or regional shellfish initiatives, and support and strengthen existing initiatives
	Work with partners to implement efficient consultations under the Magnuson-Stevens Fishery Conservation and Management Act (MSA) and the Endangered Species Act (ESA)
Develop and execute an effective framework for aquaculture in federal waters	Engage Regional Fishery Management Councils and implement their actions, including: • Implement the Gulf of Mexico Fishery Management Plan for Offshore Aquaculture • Support aquaculture amendments for the Western Pacific Fishery Management Council
	Develop regional environmental reviews (e.g., National Environmental Policy Act documents) for various culture methods and gear types to streamline review of permits
	Maintain or develop inter-agency offshore aquaculture working groups in regions where offshore aquaculture is underway or proposed
	Work with federal partners to establish appropriate processes and lead agencies for National Environmental Policy Act assessments for aquaculture projects in federal waters
	Work with partners to improve processes for issuing short-term permits for aquaculture research or demonstration projects in federal waters
Apply robust science to regulatory and management processes	Review and identify existing scientific findings and essential technical information that may inform and improve efficiency of permitting decisions
	Identify information and science gaps that delay permitting decisions and address them through internal NOAA research, grants to external partners, and international collaborations
	Translate, provide, and ensure the use of best available scientific information in permitting processes, especially NOAA research products and management tools

Goal 2: Tools for Sustainable Management

Encourage environmentally responsible marine aquaculture using best available science

Agency aquaculture policies, administration priorities, and legislative mandates charge NOAA with ensuring that U.S. marine aquaculture develops sustainably, in concert with healthy, productive, and resilient coastal and ocean ecosystems.

In order to do so, NOAA must continue to advance the understanding of the potential environmental effects of marine aquaculture (beneficial and adverse) and work with partners to ensure this information is applied in management and permitting decisions. NOAA's primary approach is to develop tools for management that distill necessary scientific information, allowing aquaculture managers to make critical and expedient permitting and management decisions. Tools for management are developed by NOAA's in-house researchers and by NOAA partners, often through NOAA's external grant programs. These tools are intended for aquaculture managers both inside and outside of NOAA (e.g., federal, state, local, and tribal agencies, and other governing bodies).

Examples of NOAA's tools for management include developing, refining, and applying siting, monitoring, and benthic impact models; quantifying the ecosystem services of aquaculture; and assessing aquaculture's interactions with protected species and fish habitats (e.g., marine mammals and eelgrass). [9]

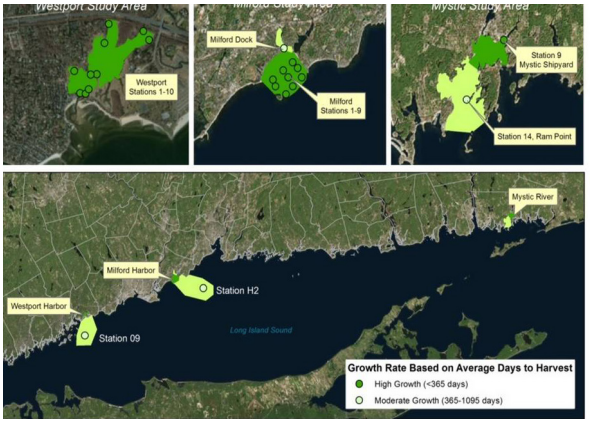
Not only must NOAA develop the needed tools to help answer the most critical management questions, but these tools must be accurate and easy for aquaculture managers to use and understand. NOAA must also refine existing tools for accuracy and useability.

NOAA's tools for management are of no benefit if they are not applied in management settings. NOAA must expand efforts to work with key partners—including federal, state, and local agencies, tribal groups, industry, and NGOs—to ensure that the best available scientific information is applied in management settings and that permitting decisions reflect this information.

Coordinating Aquaculture Science

In 2014, the White House Office of Science and Technology Policy released a National Strategic Plan for Federal Aquaculture Research. The Federal Plan directs partner agencies, including NOAA, to improve coordination and implement nine strategic research priorities. As a first step, NOAA Fisheries will inventory and assess its aquaculture science program through a rigorous peer-reviewed process. This "Aquaculture Science Review" will be finalized in 2016.

Objectives for Goals 2 and 3 align with priorities outlined in the Federal Plan. Strategies have been adapted for NOAA's role in fulfilling the Federal Plan.



[9] NOS' National Centers for Coastal Ocean Science (NCCOS) is a key partner and leads several of these activities.

Goal 2: Tools for Management

Objectives	Strategies
Advance the understanding of the interactions of aquaculture and the environment	Develop and refine siting tools and ecological forecasting models to inform aquaculture siting and management decisions
	Increase the understanding of ecosystem services provided by commercial aquaculture and work with partners to develop effective ways of accounting for these benefits economically and in management plans
	Develop best management practices to reduce potential negative environmental effects of aquaculture operations
	Advance the understanding of aquaculture as a tool for recovering protected species, restoring habitats, enhancing stocks of commercially and recreationally important species, and improving stock assessments
	Assess the impacts of environmental change (including ocean acidification) on marine aquaculture, as well as aquaculture's role in mitigating environmental change
Employ genetics to protect natural populations	Develop, test, and apply genetic risk models to aid in regulation and management of commercial aquaculture and stock enhancement
	Advance techniques to reduce the risks of undesired genetic impacts on wild populations
Counter disease in aquatic organisms and improve biosecurity	Support federal partners in strengthening capacities for responding to aquatic animal health challenges, including improving diagnostic tools, preventative measures, and treatments
	Work with federal and industry partners to implement the National Aquatic Animal Health Plan
	Support federal partners to ensure effective aquatic animal health management for aquaculture in federal waters

Goal 3: Technology Development and Transfer

Develop technologies and provide extension services for the marine aquaculture sector

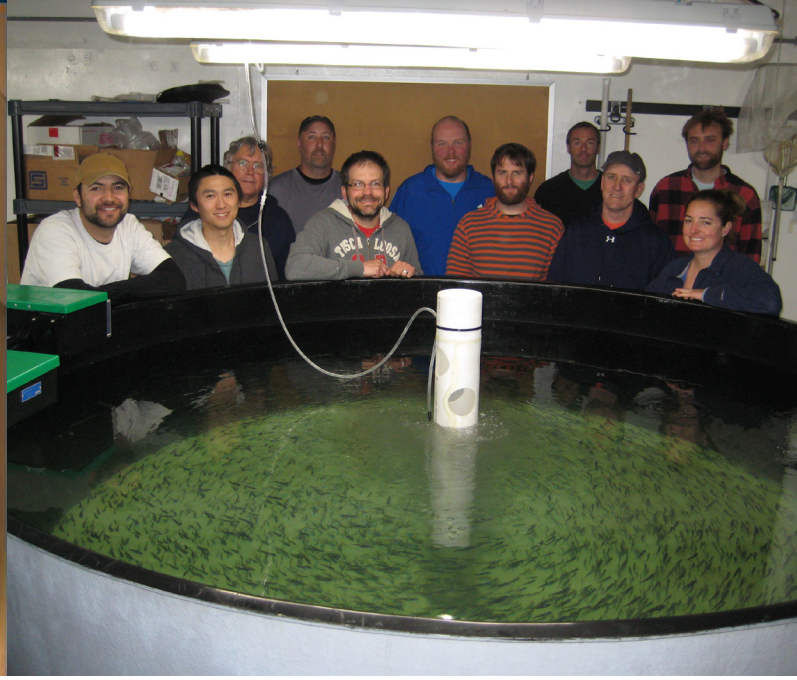
Compared to other forms of agriculture, marine aquaculture is new and dynamic. Aquaculture innovation based on robust science and technology development is one of the strongest drivers for continuous industry improvement to adapt to new opportunities and changing environmental conditions. Examples of industry needs include refining culture methods for existing aquaculture species; bringing new species "online"; addressing ocean acidification; improving feeds, vaccines, and vaccine delivery systems; engineering solutions for offshore waters and for recirculating aquaculture systems; advancing genetic, genomic, and breeding programs; and refining methods for species and habitat enhancement and restoration.

Goal 3 applies to NOAA's efforts to support marine aquaculture through technology development and transfer. Much of NOAA's in-house research activities are directed at supporting management needs (see Goal 2). NOAA also conducts research to support technology development and provide science services in support of industry needs and the broader aquaculture community, frequently in partnership with researchers in universities, industry, NGOs, states, and tribal groups to leverage resources, expertise, and capabilities.

NOAA grant programs that support U.S. marine aquaculture include the Oceanic and Atmospheric Research (OAR) National Sea Grant College Program (Sea Grant), the Saltonstall-Kennedy Grant Program, and the Small Business Innovation Research (SBIR) program. These programs leverage NOAA resources through partnerships with external researchers and institutions. In addition, NOAA engages in private sector and public collaborations on aquaculture technology development through Cooperative Research and Development Agreements and patenting and licensing technologies.

Marine aquaculture technology and methods must be transferred to and adopted by industry partners, coastal communities, and coastal managers to be effective. Sea Grant extension agents play a critical educational role in this step. This integrated model—in-house research, grants to partners, and extension services—has been applied with great success to U.S. terrestrial agriculture for the U.S. Department of Agriculture. The systems in place for marine aquaculture are not as extensive as those for terrestrial farmers, but numerous state programs still provide valuable services and create jobs in coastal communities.

The objectives and strategies below apply to in-house research at NOAA Fisheries Science Centers, in collaboration with various partners (e.g., international, industry, NGO, and academic researchers), and research by external partners funded by Sea Grant and NOAA Fisheries grants.



Goal 3: Technology Development and Transfer

Objectives	Strategies
Create a skilled workforce and enhance technology transfer	Expand partnerships to acquire, adapt, and transfer aquaculture technologies to the U.S. marine aquaculture industry
	Support extension services through National Sea Grant Extension competitions and other methods
Improve production efficiency and well-being	Develop and refine hatchery methods and technical capabilities for marine organisms for commercial production and restoration of native fish and shellfish
	Advance understanding of the physiology of marine organisms in aquaculture settings to improve commercial aquaculture production and inform population and ecosystem modeling for wild stocks
Employ genetics to increase productivity	Develop and disseminate genetic, genomics, and breeding tools and programs to maximize production efficiency and the environmental compatibility of aquaculture
Improve nutrition and develop feeds	Increase the availability of complete feeds for aquaculture species, with reduced reliance on marine fish meal and fish oil from directed fisheries
	Work with federal partners to increase the number and types of ingredients available to feed manufacturers
Improve performance of production systems	Engineer improved aquaculture systems for all stages of the aquaculture production cycle
Develop and use socioeconomic and business research to advance domestic aquaculture	Work with partner federal and state agencies and industry to improve data collection methods and the quality of annual national aquaculture production statistics
	Conduct socioeconomic and job impact analyses for marine aquaculture
	Provide additional socioeconomic information including research on U.S. seafood demand; local, regional, and international markets; and the interaction of U.S. marine aquaculture with capture fisheries

Goal 4: Informed Public

Improve public understanding of marine aquaculture

Expert analyses show that marine aquaculture can be a resource-efficient, environmentally sustainable form of food production that can play a significant role in increasing seafood supply, improving human nutrition, and creating jobs. However, most of the public still has limited understanding of aquaculture and may encounter information that can be out of date, inaccurate, or incomplete. Public perception of aquaculture is a significant barrier to marine aquaculture development in the United States. Integral to NOAA's aquaculture mission is advancing public understanding of marine aquaculture practices; the associated environmental, social, and economic challenges and benefits; the health benefits of eating seafood; and the science, services, and policies NOAA has to offer in support of aquaculture.

Many stakeholders want to understand the impacts of aquaculture, including an assessment of the risks and the benefits based on the best available science. This is especially important for coastal communities, where aquaculture is a leading employer and part of community culture and history. NOAA has a responsibility to provide the public with factual, scientific evidence information about aquaculture. This can only be achieved through collaborative engagement with the public we serve.

Outreach efforts will engage the public with accurate information about the state of marine aquaculture research and management and key initiatives by NOAA and its partners. Success in cultivating public understanding and support for marine aquaculture will require NOAA to expand external partnerships with key organizations to achieve common goals.

Goal 4: Informed Public

Objectives	Strategies
Provide accessible, relevant, and up-to-date information on marine aquaculture to the public	Enhance the content and usability of agency websites and social media, particularly for science information, permitting information, and grant opportunities
	Design communications tools (e.g., infographics, fact sheets) to communicate scientific and regulatory information to the general public and targeted audiences
	Present information at professional conferences and public meetings of strategic interest
	Work with partners to facilitate public access to environmental information on aquaculture operations
	Translate scientific information for varied audiences, including non-scientists and those unfamiliar with technical aquaculture information
Enhance NOAA's national and regional capabilities to support communications and outreach	Increase awareness, understanding, and support for aquaculture activities within Commerce, NOAA, NOAA Fisheries, and NOAA Fisheries Regional Offices and Science Centers communications and outreach activities
	Develop a coordinated approach to communications among the Office of Aquaculture, Regional Coordinators, and communications teams in regions
	Develop a coordinated communication system among NOAA Fisheries, NOS, and OAR
Build partnerships to increase outreach and education capacity	Partner with educational organizations such as Sea Grant universities, aquariums, and culinary schools to disseminate knowledge and increase understanding of marine aquaculture
	Partner with other governmental agencies, industry groups, NGOs, and international partners to develop collaborative communications approaches for marine aquaculture

Cross-Cutting Strategies

We have identified several strategies that apply to many of the goals and objectives developed in this Plan that are critical to achieving our aquaculture mission:

Strengthen partnerships: Our efforts to advance U.S. marine aquaculture are limited by available resources. To fulfill all of the goals and objectives presented, we will work effectively with our partners, including federal, state, local, and tribal agencies; industry; NGOs; and academic and international partners. We must not only build upon existing partnerships but also develop new ones with key organizations to leverage resources in pursuit of common goals.

Improve external communications: Effective external communication is foundational to achieving the goals and objectives developed in this Plan. We must continue an interactive dialogue and take a "no surprises" approach when communicating with our stakeholders. We will ensure that our stakeholders receive the best service possible by being responsive, transparent, and efficient in everything we do. To do so, we must work to improve internal communications within our agency to ensure clear and consistent external communications regarding marine aquaculture. Many parts of NOAA play a role in the regulation, science, and provision of services for marine aquaculture. Functioning effectively will require that NOAA personnel both within and outside of the NOAA Aquaculture Program are knowledgeable about aquaculture science and management and are committed to implementing our aquaculture mission. Building internal support for aquaculture will take commitment and leadership from Aquaculture Program staff to educate, improve communications, and build relationships throughout NOAA.

Build infrastructure to support marine aquaculture: Many parts of NOAA play a role in the regulation, science, and provision of services for marine aquaculture. Functioning effectively will require that NOAA personnel both within and outside of the Office of Aquaculture are well informed about aquaculture science and management and are committed to implementing our aquaculture mission. This will take commitment and leadership from Office of Aquaculture staff to continue efforts to conduct "in-reach" to educate, improve communications, and build relationships throughout NOAA.

Sound program management: We must implement this Plan with discipline, consistency, and accountability and ensure that resources and staff are aligned to our priorities. We also must routinely evaluate our science and management programs to assess our results and to ensure we are making progress in implementing this Plan.

Deliverables

The table below displays selected deliverables and actions for the Aquaculture Program for the FY 2016-2020 time period. A comprehensive list of program activities will be developed annually in an Aquaculture Annual Operating Plan.

Organization	Deliverables	FY 16	FY 17	FY 18	FY 19	FY 20
Headquarters	Finalize a Memorandum of Understanding among federal agencies for aquaculture permitting in federal waters of the Gulf of Mexico (Goal 1)	✓				
	Complete Aquaculture Science Review and develop and implement Aquaculture Science Strategic Plan (Goals 2, 3)	✓	✓			
	Expand external funding opportunities for aquaculture including Saltonstall-Kennedy, SBIR, Sea Grant competitions and public-private partnerships (Goals 2, 3)	✓	✓	✓	✓	✓
	Improve aquaculture online resources particularly science web-pages (Goals 1, 2, 3, 4)	✓	✓			
	Complete an economic impact analysis for marine aquaculture and improve the accuracy of annual aquaculture production statistics (Goal 3)	✓	✓	✓	✓	✓
All Regions	Assist with grants management, including Saltonstall-Kennedy (Goal 2, 3)	✓	✓	✓	✓	✓
	Collaborate with Protected Resources and Habitat Conservation programs to complete Endangered Species Act/Essential Fish Habitat consultations on Army Corps of Engineers permits, as appropriate (Goal 1)	✓	✓	✓	✓	✓
	Improve reporting of regional aquaculture production statistics (Goal 3)	✓	✓	✓	✓	✓
	Actively engage other offices within NOAA and other agencies involved in permitting aquaculture offshore, to disseminate scientific findings in key NOAA and outside scientific research to establish a sound, scientific rationale for the review of permit applications, and for establishing siting, monitoring, and BMP requirements of permittees (Goals 1, 2)	✓	✓	✓	✓	✓
Greater Atlantic Regional Office	Work with state and federal partners to identify and implement ways to improve the permit processes for aquaculture, particularly for shellfish aquaculture (Goal 1)	✓	✓	✓	✓	✓
	Conduct a review of mussel aquaculture and protected resource interactions (Goal 1)	✓	✓			
Southeast Regional Office	In coordination with federal agencies, develop a regional permit review process and implement the Fishery Management Plan for Offshore Aquaculture in the Gulf of Mexico (Goal 1)	✓	✓			
	Support the development of off-bottom shellfish aquaculture in the Gulf of Mexico (Goals 1, 3)	✓	✓	✓	✓	✓

Organization	Deliverables	FY 16	FY 17	FY 18	FY 19	FY 20
West Coast Regional Office	Complete NOAA actions identified under the Washington, California, and Oregon Shellfish Initiatives (Goals 1, 2, 3, 4)	✓	✓	✓	✓	✓
	Work with state agencies and local governments in Washington to improve aquaculture guidance for updates of Shoreline Master Programs (Goal 1)	✓	✓			
	Work with local, state, and federal partners to ensure timely and efficient permitting decisions for proposed projects in state and federal waters (Goal 1)	✓	✓	✓	✓	✓
Pacific Islands Regional Office	Provide regulatory guidance through the Offshore Aquaculture working group (Goal 1)	✓	✓	✓	✓	✓
	Support aquaculture amendments for the Western Pacific Fishery Management Council and develop capability to issue permits for commercial-scale aquaculture in federal waters (Goal 1)	✓	✓	✓		
	Support the issuance of programmatic permits for restoration of Hawaiian fish ponds (Goal 1)	✓	✓	✓	✓	✓
Alaska Regional Office	Coordinate with partners to support Alaska shellfish initiative (Goals 1, 2, 3, 4)	✓	✓	✓	✓	✓
Northeast Fisheries Science Center*	Provide technical assistance for shellfish hatchery methods, probiotics, and micro-algae culture (Goal 3)	✓	✓	✓	✓	✓
	Conduct research on the ecosystem services of aquaculture and the response of shellfish to changing environmental conditions (Goals 2, 3)	✓	✓	✓	✓	✓
Southeast Fisheries Science Center*	Support the Southeast Regional Office in assessing the environmental effects of prospective aquaculture in federal waters of the Gulf of Mexico in Collaboration with the NWFSC and NCCOS (Goal 2)	✓	✓	✓	✓	✓
Northwest Fisheries Science Center*	Operationalize and apply the OMEGA (genetic impacts) model to additional species/stocks (e.g., red drum) (Goal 2)	✓	✓	✓	✓	
	Complete research products on the environmental effects and ecosystem services of shellfish aquaculture (Goals 2, 3)	✓	✓	✓	✓	✓
	Work with partners to advance production methods (i.e., larval rearing technology, genetics, and genomics) for key species including sablefish, Olympia oysters, salmon, seaweed, and abalone (Goals 2, 3)	✓	✓	✓	✓	✓
	Develop "tools for rules" for disease modeling (Goals 2, 3)		✓	✓	✓	
Southwest Fisheries Science Center*	Provide scientific support to assess the environmental effects of aquaculture in federal waters off California (Goal 2, 3)		✓	✓	✓	✓
	Expand captive breeding programs and out-planting for endangered abalone, consistent with NOAA Fisheries policy and recovery plans (Goal 2)	✓	✓	✓	✓	✓
	Advance production methods (i.e., larval rearing technology, genetics, and genomics) for key species including yellowtail, white seabass and endangered abalone (Goals 2, 3)	✓	✓	✓	✓	✓

Organization	Deliverables	FY 16	FY 17	FY 18	FY 19	FY 20
Pacific Islands Fisheries Science Center*	Provide science support to assess the environmental effects of aquaculture in federal waters off Hawaii (Goal 2, 3)		✓	✓	✓	✓
Alaska Fisheries Science Center*	Develop husbandry techniques to raise king crab to enhance wild populations	✓	✓	✓	✓	✓
	Use aquaculture as a tool to investigate the effects of climate change on wild king salmon life history and genetics.	✓	✓	✓	✓	✓
OAR National Sea Grant College Program**	Effectively manage aquaculture grant competitions for aquaculture development and extension and coordinate work of aquaculture extension agents (Goal 3)	✓	✓	✓	✓	✓
NOS National Centers for Coastal Ocean Science (NCCOS)**	Develop tools for coastal managers, including ecological assessments and forecasts, spatial planning tools, climate change assessments, and innovative technologies (Goals 1, 2, 3, 4)	✓	✓	✓	✓	✓

* Additional aquaculture science deliverables, including those addressing emerging science needs, will be identified through the NOAA Aquaculture Science Review in 2016.

** The OAR National Sea Grant College Program and NOS NCCOS are each in the process of developing aquaculture strategic plans specific to their respective organization

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Appendix 1 - Program Overview

1. Legal, Regulatory, and Policy Drivers

Several federal laws drive NOAA's Aquaculture Program, each of which has been considered in the development of this Plan. These include the:

- National Aquaculture Act of 1980
- Magnuson-Stevens Fishery Conservation and Management Act (MSA)
- Fish and Wildlife Coordination Act
- National Environmental Policy Act (NEPA)
- Marine Mammal Protection Act (MMPA)
- Endangered Species Act (ESA)

NOAA's aquaculture activities and this plan align with and support national and agency-wide initiatives and policies, including:

- The National Strategic Plan for Federal Aquaculture Research (2014-2019)
- NOAA and Department of Commerce Aquaculture Policies (2011)
- The National Ocean Policy Implementation Plan (2013)
- NOAA 5 year Research and Development Plan (2013)
- NOAA Fisheries Priorities and Annual Guidance

2. Interagency Coordination

NOAA coordinates interagency activities through the Interagency Working Group on Aquaculture (IWG-A), which includes membership from all federal agencies involved in aquaculture regulation and science. The Director of the Office of Aquaculture represents the Secretary of Commerce on the IWG-A and serves as co-chair and member of the Executive Committee of the IWG-A. A staff member of the National Sea Grant College Program Office also serves on the Executive Committee. NOAA staff also participate in interagency working groups to coordinate aquaculture activities at the regional level.

3. NOAA's Aquaculture Program

NOAA's aquaculture activities, collectively known informally as the NOAA Aquaculture Program, are conducted in three NOAA line offices: NOAA Fisheries, the Office of Oceanic and Atmospheric Research (OAR), and the National Ocean Service (NOS), each with distinct and complementary roles.

3a. NOAA Fisheries (NMFS) Office of Aquaculture

The Office of Aquaculture is part of NOAA Fisheries and is managed from Headquarters in Silver Spring, Maryland. NOAA Fisheries focuses on regulatory, technical, and scientific services required for federal development and management of marine aquaculture within the context of NOAA's marine stewardship missions. The Headquarters Office provides strategic direction for NOAA Fisheries' Aquaculture Program, manages budgets, coordinates science and outreach activities, addresses regulatory issues, conducts grants review and management, coordinates international activities, and serves in a liaison role with other offices, federal agencies, and the public.

NOAA Fisheries has five regional aquaculture coordinators, one in each Regional Office (except Alaska). Regional coordinators focus on regulatory and permitting activities in federal and state waters; serve as liaisons with stakeholders and federal, state, local, and tribal governments; assist with grants management; and foster science collaborations. Regional Coordinators report to Regional Administrators, but closely coordinate their activities with the Headquarters Office of Aquaculture.

NOAA Fisheries also conducts the majority of NOAA's in-house aquaculture research, with activities at the Northeast Fisheries Science Center in Milford, Connecticut; Northwest Fisheries Science Center in Seattle, Washington (Manchester and Montlake); and an emerging program at the Southwest Fisheries Science Center in La Jolla, California. Additional researchers at other Science Centers (Pacific Islands, Southeast, and Alaska) also work on aquaculture projects. Research efforts focus on designing and refining scientific "tools for management" to inform permitting decisions, evaluating the

NOAA FISHERIES

Role of Headquarters Office of Aquaculture

- Drive strategy and lead a coordinated Aquaculture Program
- Build internal support for the Aquaculture Program
- Provide guidance to regional decision-makers to improve consistency in permitting
- Support regions in designing and implementing regulations for aquaculture in state/federal waters
- Coordinate science activities and drive science strategy
- Coordinate outreach activities
- Budget planning and execution
- Coordinate international science and policy activities
- Assist with grants management

Role of Regional Coordinators

- Work with partners to improve permitting processes in federal and state waters
- Facilitate communications with stakeholders and federal, state, local, and tribal governments
- Assist with grants management
- Communicate the best available scientific information to managers, decision-makers, and stakeholders on the benefits, impacts, and management of marine aquaculture
- Foster communication between scientists and managers to identify and evaluate research and information needs to advance the marine aquaculture sector

ecosystem services of marine aquaculture, understanding changing ocean conditions, and developing and refining aquaculture technologies. The Milford Laboratory has historically focused primarily on shellfish aquaculture, with some work on finfish and changing ocean conditions. The Manchester Laboratory has focused on finfish aquaculture and technology development, but shellfish capabilities have recently been reestablished with the opening of the Kenneth Chew Shellfish Research and Restoration Hatchery.

In FY 2015, Congress appropriated $5.7 million to an aquaculture-specific budget line, which is managed by the headquarters Office of Aquaculture. While allocation of funding varies by year, typically half is allocated to headquarters and regional coordinators (staff time). The remaining half is put toward internal science center and regional projects. Funding determinations are made through an internal competition, as budgets allow. In addition to the aquaculture budget line, three primary budget lines (and several other smaller lines) are used for NOAA Fisheries Science Activities (Appendix 2).

NOAA Fisheries also provides extramural funding to support industry development through the Saltonstall-Kennedy and Small Business Innovation Research Programs and the Marine Fisheries Initiative (MARFIN). The amount of funding provided for aquaculture projects in a given year depends on a number of factors, including the number and quality of proposals received and the availability of funding.

Examples of Recent Efforts at NOAA Fisheries

Gulf of Mexico Aquaculture Plan

The Southeast Regional Office and the Office of Aquaculture are working together to issue a Final Rule for the Fishery Management Plan for Regulating Offshore Aquaculture in the Gulf of Mexico. Concurrently, NOAA Fisheries is leading efforts to ensure a coordinated permit process among federal agencies once the Final Rule is implemented.

Shellfish Research

The Northeast Fisheries Science Center's Milford laboratory is a global leader in shellfish research, providing invaluable technology to the industry. Recently, scientists at Milford developed probiotics to aid in oyster larvae survival.

In practice, the headquarters Office of Aquaculture coordinates and leads the broader NOAA Aquaculture Program. Other components of the NOAA program are described below.

3b. OAR National Sea Grant College Program

The National Sea Grant College Program housed within OAR integrates aquaculture research, extension, and education through the national office and 33 state Sea Grant university programs across the U.S. coasts and Great Lakes. Sea Grant manages NOAA's primary extramural grant competition for aquaculture applied research, technology transfer, and extension.

Examples of Recent Efforts at OAR National Sea Grant College Program

Commercial Production of Clams

Florida Sea Grant research and extension faculty working with the clam industry helped eliminate barriers to commercial production of Sunray Venus clams. Providing this second species for Florida aquaculture has led to a more diverse industry, as well as an increase in local jobs and income.

Multi-species Aquaculture

Researchers from New Hampshire Sea Grant have helped to create a multi-species aquaculture of steelhead trout, mussels and sugar kelp, creating additional income for fishermen, and improving water quality. Fishermen harvested over 2400 lbs. of trout, 1255 lbs. of kelp, collected over 12 million mussel seed, and put over four tons of mussels into cultivation.

These grants support activities by universities, industry, and NGOs. Sea Grant extension agents live and work in coastal communities, providing science-based information to local governments and citizen groups, and transferring technologies to industry. About 25 to 30 extension professionals spend at least part of their time working on aquaculture extension. In FY 2015, the National Sea Grant College Program received a $4.5 million appropriation for its Marine Aquaculture Program. In addition, state Sea Grant programs typically contribute additional federal Sea Grant funds toward aquaculture projects (approximately $2 million per year). The federal funds leverage additional state and private funding.

Examples of Recent Efforts at NOS NCCOS

Marine Cage Culture and the Environment

NCCOS scientists analyzed environmental concerns and recommendations related to marine cage culture around the world. The extensive report concluded that proper coastal planning tools and environmental oversight can support sustainable growth of aquaculture in the coastal ocean.

CanVis For Aquaculture

NCCOS researchers are adapting CanVis, a visualization software package used in coastal planning, to assess and communicate the visual impacts related to marine aquaculture development. Simulations are being used in regional workshops to support dialogue with coastal managers, industry participants, and stakeholders.

3c. NOS National Centers for Coastal Ocean Science (NCCOS)

NOS translates science, tools and services into action to address threats to coastal environments and works to maintain both healthy coasts and healthy economies. As part of NOS, the National Centers for Coastal Ocean Service (NCCOS) Coastal Aquaculture Planning and Environmental Science (CAPES) program in Beaufort, North Carolina specializes in understanding the environmental interactions of aquaculture with marine and human ecosystems. CAPES interdisciplinary scientists leverage NOS experience in coastal planning to address conflicts among ocean uses, to inform and support public outreach and education efforts, and to increase awareness of the environmental, economic, and social opportunities aquaculture can provide coastal communities. The CAPES research portfolio focuses on aquaculture environmental impact monitoring and modeling, coastal planning, and climate change. Expertise is directed toward developing coastal planning tools for sustainable aquaculture development and leveraging partnerships within the National Centers for Coastal Ocean Science (NCCOS) and the Office for Coastal Management (OCM).

3d. Other Affiliated NOAA Programs

Other programs also contribute to the NOAA Fisheries' aquaculture mission:

- The NMFS Seafood Inspection Program (SIP) provides services to the aquaculture industry such as sanitation inspections, system and process audits, product inspection and grading, and export certifications. In addition, the SIP advises the agency on aquatic animal health issues in close coordination with the Office of Aquaculture, NMFS science centers, and the National Seafood Inspection Laboratory. The SIP and the Office of Aquaculture provide agency representation to the interagency National Aquatic Animal Health Task Force.

- The National Seafood Inspection Laboratory (NSIL) in Pascagoula, Mississippi, and the Northwest Fisheries Science Center conduct laboratory analyses on seafood quality and pathogens and toxic chemicals that may affect seafood. NSIL represents NOAA at meetings of the Interstate Shellfish Sanitation Conference.

- The Sustainable Fisheries Program issues permits for aquaculture in federal waters under MSA, including ensuring compliance with NEPA and other federal regulatory requirements.

- The Office of Habitat Conservation (OHC) works closely with the Office of Aquaculture as a key partner in the implementation of the National Shellfish Initiative. OHC provides technical and regulatory expertise on the interactions between aquaculture and Essential Fish Habitat (EFH). Habitat Divisions within NMFS regional offices review federal permit applications for aquaculture to ensure compliance with the EFH provisions of the MSA. OHC also works on restoring native bivalve shellfish populations as one of four priority habitat restoration approaches to rebuilding fisheries, recovering protected resources, and improving the resiliency of coastal communities. This work includes the use of shellfish aquaculture as a tool for shellfish restoration.

- The Protected Resources Program reviews federal permit applications for aquaculture to ensure compliance with the MMPA and the ESA. Under ESA, the Program can also use controlled propagation of a listed species (aquaculture) as a tool when recommended in an approved recovery plan or when determined to be necessary to prevent extinction of a species (e.g. abalone, Atlantic salmon, several species of Pacific salmon, and corals).

- The NOAA Ocean Acidification Program helps to further scientific understanding and predict changes in the Earth's environment as a consequence of continued acidification of the oceans and Great Lakes. Aquaculture is utilized as a tool to conduct research projects and the marine aquaculture sector also is an end user of this research.

- Additional NOS Programs including the Integrated Ocean Observing System (IOOS) and Harmful Algal Bloom Operational Forecast System provide essential data and services to ensure proper ecological and human health management of the aquaculture sector.

Appendix 2 - NOAA Aquaculture Funding History

Table A1: Total NOAA Fisheries Aquaculture Funding (Thousands of Dollars)

Organization	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY2014	FY 2015
NOAA Fisheries HQ (e.g., management, outreach)	$2,361	$1,736	$1,705	$1,953	$1,360	$1,569	$1,406	$1,433	$1,328
Regional Coordinators	$135	$132	$229	$428	$589	$906	$873	$908	$887
Northeast Fisheries Science Center	$3,132	$3,758	$4,200	$4,850	$4,802	$4,176	$4,320	$3,420	$3,095
Northwest Fisheries Science Center	$1,838	$2,248	$2,591	$3,457	$3,187	$3,092	$2,636	$2,687	$2,905
Other Fisheries Science Centers	$335	$0	$54	$161	$726	$239	$205	$144	$172
Transfers to OAR and NOS	$19	$733	$494	$433	$282	$475	$296	$257	$314
Total	$7,820	$8,607	$9,273	$11,282	$10,946	$10,457	$9,736	$8,849	$8,701

Table A2: Extramural Funding for Aquaculture Under Saltonstall-Kennedy Grants Program

	FY 2008**	FY2009	FY 2010	FY 2011*	FY 2012*	FY 2013	FY 2014***	FY 2015****
# 0f aquaculture projects funded	1	19	8	-	-	-	6	16
Total funding for aquaculture projects	$69,791	$4,202,438	$1,471,129	-	-	-	$1,561,297	$4,763,458
Total S-K grant competition	$2,613,479	$8,605,617	$4,835,204	-	-	-	$10,511,660	$25,000,000
% funding to aquaculture projects	3%	49%	30%	-	-	-	15%	19%

* There was no S-K grant competition in FY 2011, 2012, 2013 **Aquaculture was not a funding priority in FY 2008 *** FY 2014 competition includes FY 2013 funds ****FY 2015 competition includes FY 2014 fund

Table A3: Extramural Funding for Aquaculture Under NOAA/Department of Commerce SBIR Program

	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
# of aquaculture projects funded	3	3	3	4	2	1	2	1	3
SBIR Phase 1 funding	$187,895	$94,651	$180,975	$376,998	-	$95,000	$95,000	$94,999	$189,647
SBIR Phase 2 funding	$300,000	$559,000	$299,998	-	$598,427	-	$397,510	_	$399,999
Total aquaculture project funding	$487,895	$653,651	$480,973	$376,998	$598,427	$95,000	$492,510	$94,999	$589,646

Table A4: Extramural Funding for Aquaculture under OAR National Sea Grant College Program*

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
# of aquaculture projects funded	23	11	36	33	40	47	25	30
Total aquaculture project funding	$4,603	$1,578	$4,800	$4,313	$4,318	$4,147	$4,363	$4,388

* Table includes core funding

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