# ALASKA MARICULTURE DEVELOPMENT PLAN

STATE OF ALASKA

MARCH 23, 2018

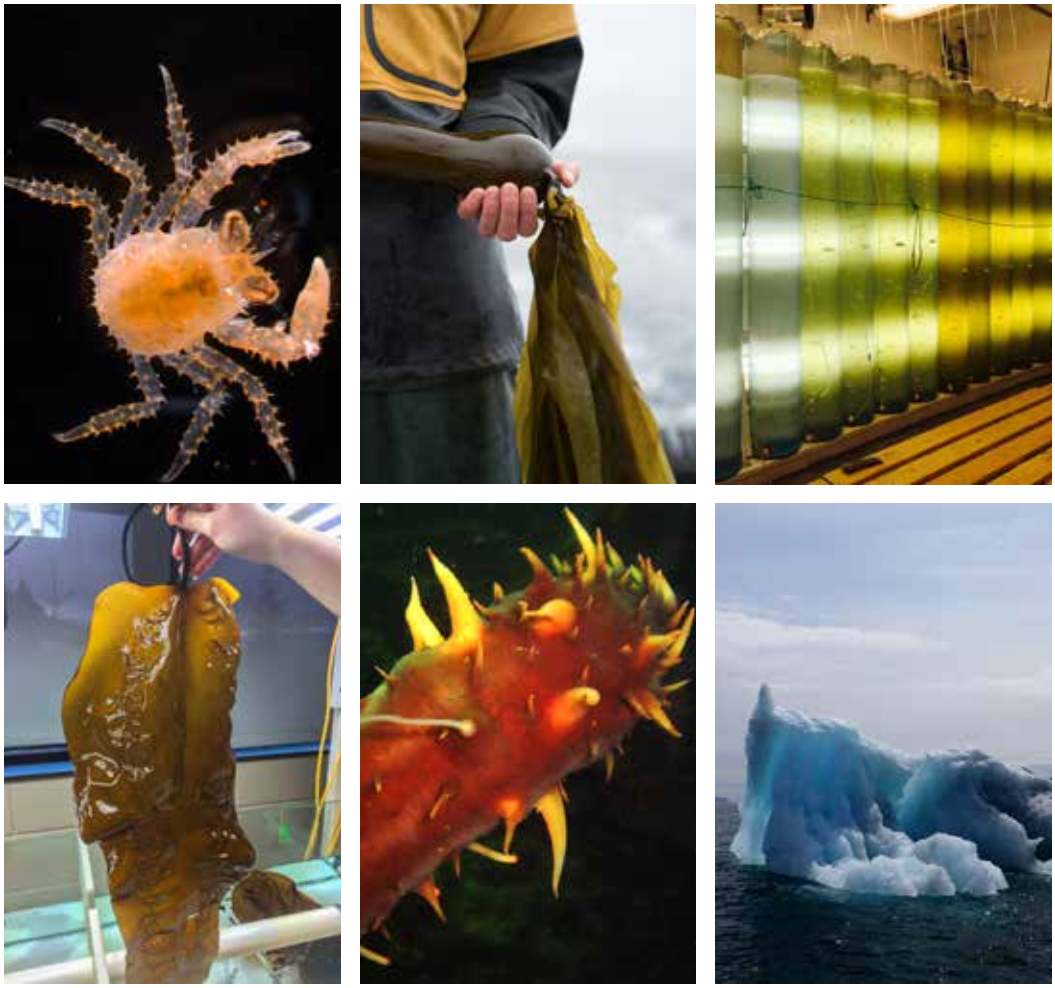

*Photo credit clockwise from top left: King crab juvenile by Celeste Leroux; bull kelp provided by Barnacle Foods; algae tanks in OceansAlaska shellfish hatchery provided by OceansAlaska; fertile blade of ribbon kelp provided by Hump Island Oyster Co.; spawning sea cucumber provided by SARDFA; icebergs in pristine Alaska waters provided by Alaska Seafood.*

*Cover photos: Large photo: Bull kelp by ©"TheMarineDetective.com". Small photos from left to right: Oyster spat ready for sale in a nursery FLUPSY by Cynthia Pring-Ham; juvenile king crab by Celeste Leroux; oyster and seaweed farm near Ketchikan, Alaska, provided by Hump Island Oyster Co.*

*Back cover photos from left to right: Nick Mangini of Kodiak Island Sustainable Seaweed harvests kelp, by Trevor Sande; oysters on the half-shell, by Jakolof Bay Oyster Company; oyster spat which is set, by OceansAlaska. Photo bottom: "Mariculture – Made in Alaska" graphic by artist Craig Updegrove and provided by Alaska Dept. of Commerce, Community and Economic Development, Division of Economic Development*

*Layout and design by Naomi Hagelund, Aleutian Pribilof Island Community Development Association (APICDA).*

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# MESSAGE FROM THE GOVERNOR

Aquatic plants and shellfish present a significant and sustainable economic opportunity for coastal Alaska communities, and now is the time for business leaders and policymakers to take the necessary steps for the industry to reach its full potential.

Our state has more than 30,000 miles of clean, pristine, nutrient-rich coastline, which produce more than 50 percent of seafood in the United States. However, this ecosystem also produces much more than fish: kelp, seaweed, geoducks, clams, and many other species are all also abundant. These species represent renewable resources that have long been crucial to subsistence and livelihoods of many Alaskans, and now we must prove our commitment to sustainability principles to ensure future generations will also enjoy these resources.

*Governor Walker visits with Matthew Kern of Barnacle Foods while promoting the challenge to Alaskans to spend $5 each week on Alaska Grown products; provided by the Governor's Office.*

In 2016, I established the Alaska Mariculture Task Force through Administrative Order No. 280 to develop a comprehensive plan for the development of a viable and sustainable mariculture industry that produces shellfish and aquatic plants for the long-term benefit of Alaska's economy, environment, and communities. The Task Force represents a partnership among a broad spectrum of stakeholders.

I respect the long-term vision of Task Force participants who have been involved in this comprehensive planning process. Alaskans can accomplish great things when we collaborate, work toward a common vision, develop plans, and take actions to overcome challenges and achieve meaningful goals.

**I support this comprehensive plan, and commit the State of Alaska to work in partnership with stakeholders and agencies toward its implementation.**

Bill Walker

# MESSAGE FROM THE ALASKA MARICULTURE TASK FORCE

The members of the Task Force deeply appreciate Governor Walker's leadership in support of mariculture development, and the support of his administration in the formulation of this plan. The diverse membership, listed below, reflects a true cross section of mariculture interests and experience, broadened further by the incorporation of effective and involved Advisory Committees on each major element. The Task Force believes that this work has resulted in a realistic plan that recognizes the ideal conditions in Alaska for mariculture development, identifies the challenges ahead, and recommends strategies and solutions to achieve the State's full potential.

Alaska has all the qualities of an ideal environment for mariculture development: clean and abundant waters, hardy citizens with maritime experience, and an existing seafood industry and infrastructure. The state has research and development capacity at the University and industry level, as well as a sophisticated seafood marketing organization that effectively reaches consumers all over the nation and the world. The regulatory process and agencies are accessible, and the Legislature is on the verge of passing essential laws to help fund mariculture and allow expanded hatchery shellfish production.

*Oyster farm near Kake.*
*Photo courtesy of Sealaska.*

Along with these strengths come challenges. This plan identifies these challenges and barriers to development in the areas of investment, regulations, research and development, coordination and leadership, workforce needs, marketing and public education. The Task Force then makes detailed recommendations regarding the changes and additions needed to achieve the full potential of Alaska's opportunities. The elements, recommendations for action, and priority recommendations are presented in the body of the plan and the broader lists of recommendations from the Advisory Committees are included as appendices. The Task Force recognizes that over time priorities will change and should be updated. Long-term challenges, such as ocean acidification, climate change, sea otter population growth, and invasive species, will require more comprehensive future strategies.

We believe that mariculture development will bolster the economy of our state, in particular the coastal communities where much of the seafood infrastructure and experience already exist. This economic development will be environmentally sound, and designed to complement rather than replace existing uses. The plan is intended to increase profitability for those already engaged in mariculture, to expand participation, and to provide coordination to refine regulations, access funding and conduct needed research.

The recommended improvements and new solutions will require commitment, and an

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implementation plan. The Task Force members remain committed, and are enthusiastic about expanding Alaska's mariculture industry. The Advisory Committees identified a common theme: the need to increase capacity to implement this plan. The Task Force thus recommends the formation of an Alaska Mariculture Development Council to continue making progress to develop the mariculture industry.

Julie Decker, MTF Chair, Alaska Fisheries Development Foundation (AFDF)

Paula Cullenberg, Alaska Sea Grant (ASG)

Angel Drobnica, Aleutian Pribilof Island Community Development Association (APICDA)

Jeff Hetrick, Alutiiq Pride Shellfish Hatchery (APSH)

Heather McCarty, Central Bering Sea Fishermen's Association (CBSFA) and Alaska King Crab Research, Rehabilitation and Biology (AKCRRAB) program

Mike Navarre (current Commissioner)/Chris Hladick (former Commissioner), Alaska Department of Commerce, Community and Economic Development (ADCCED)

Sam Rabung, Alaska Department of Fish and Game (ADFG)

Dr. Michael Stekoll, University of Alaska Southeast and University of Alaska Fairbanks

Kate Sullivan, Southeast Alaska Regional Dive Fisheries Association (SARDFA)

Christopher Whitehead, Sitka Tribe of Alaska (STA) and Southeast Alaska Tribal Ocean Research (SEATOR)

Eric Wyatt, OceansAlaska (OA) and Blue Starr Oyster Company

# EXECUTIVE SUMMARY

Alaska has all the qualities of an ideal environment for mariculture development: clean and abundant waters, hardy citizens with maritime experience, and an existing seafood industry and infrastructure. The state has research and development capacity at the University and industry level, as well as a sophisticated seafood marketing organization that effectively reaches consumers all over the nation and the world.

Along with these strengths come challenges. The Alaska Mariculture Development Plan identifies these challenges and barriers in the areas of investment, regulations, research and development, coordination and leadership, workforce needs, marketing and public education.

Mariculture development will bolster the economy of our state, in particular the coastal communities where much of the seafood infrastructure and experience already exist. This economic development will be environmentally sound, and designed to complement rather than replace existing uses. The Plan is intended to increase profitability for those already engaged in mariculture, to expand participation, and to provide coordination to refine regulations, access funding and conduct needed research.

***The top priority recommendations to meet the challenges and increase capacity are:***

1) **Secure seed supply through hatcheries**
2) **Pass State legislation to A) help fund hatcheries through the Mariculture Revolving Loan Fund, and B) allow shellfish enhancement**
3) **Establish an Alaska Mariculture Development Council**
4) **Establish a Mariculture Research Center at the University of Alaska**
5) **Fill key positions to enable the growth of the industry: NOAA Aquaculture Coordinator in Alaska and Alaska Sea Grant Mariculture Specialist**

*Hump Island Oyster farm. Photo provided by Hump Island Oyster Company.*

Individual sections of the Plan, as well as the Advisory Committee reports, provide detailed explanations of these priority recommendations. In addition, the Plan calls for aligning State and Federal regulations and agency practices with stakeholder needs, with a central point of contact for prospective mariculture participants.

The Plan encourages private investment in mariculture from within Alaska and outside Alaska, in part by coordinating existing federal and state funding sources for more efficient development of the industry. Elements of the Plan acknowledge the need to build public understanding and support for mariculture, to develop new mariculture products and markets, and to grow and develop the mariculture workforce.

Finally, the Plan promotes mariculture success through Alaska Native participation. Mariculture development will benefit from the participation of Alaska Natives in every element of the process, utilizing local and traditional knowledge in the siting of farms, accessing programs and funding sources geared towards economic and workforce development, and supporting appropriate development on Native owned lands.

## VISION

Develop a viable and sustainable mariculture industry producing shellfish and aquatic plants for the long-term benefit of Alaska's economy, environment and communities.

## GOAL

Grow a $100 million mariculture industry in 20 years.

## GUIDING PRINCIPLES

SCOPE: For the purpose of this plan, mariculture is defined as enhancement, restoration, and farming of shellfish (marine invertebrates) and seaweeds (macroalgae). Finfish farming is not legal in Alaska waters.

COORDINATION & LEADERSHIP: Effective implementation of this comprehensive plan requires coordination and commitment of time and resources from local, state, federal and tribal governments, industry, communities, the University, and other interested stakeholders.

SUSTAINABILITY: Development of mariculture will be compatible with sustainability principles to maintain and improve environmental integrity, as required by the Alaska Constitution and ADF&G management practices.

ALASKA NATIVE PARTICIPATION: Mariculture development will benefit from the involvement of Alaska Natives in every element of the process.

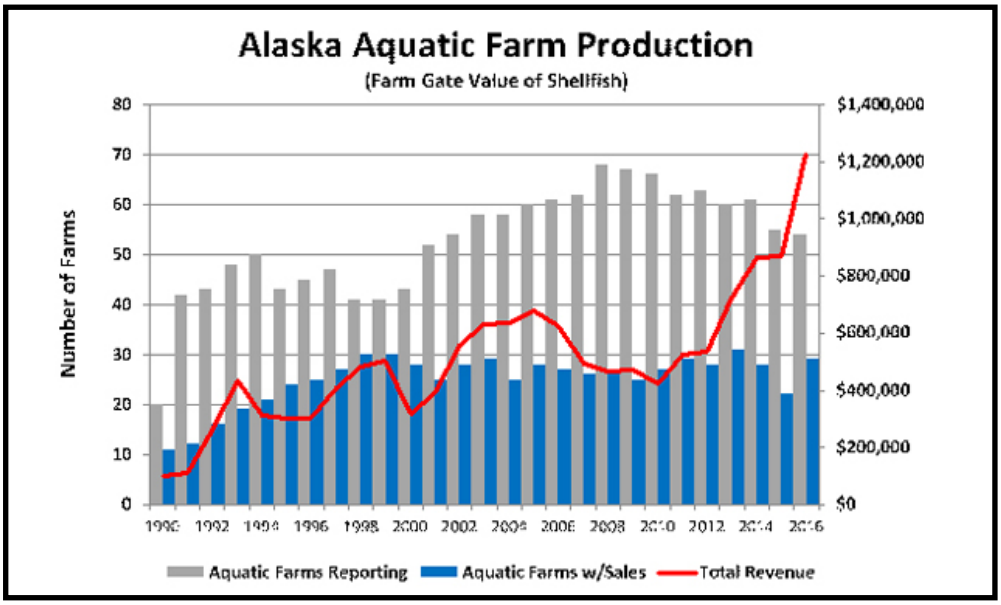
INNOVATION: Alaska presents many unique challenges, and developers will look globally to applicable research and solutions to apply to Alaska's circumstances and geography.

COMPATIBILITY: Implementation of this plan must protect existing marine uses, such as subsistence, commercial fishing, and recreation. It will also utilize Alaska assets and infrastructure.

*Beach at St. George Island, Alaska.*
*Photo by Joshua Propiokoff.*

# INTRODUCTION

In 1988, the Aquatic Farm Act (Alaska Statutes 16.40.100-199) was passed by the Alaska Legislature. Since that time, development of the mariculture industry has progressed slowly, and annual production is approximately $1 million.




During this same period, other regions of the world have seen tremendous growth in the areas of shellfish and seaweed mariculture. There is a significant opportunity for growth in Alaska's seafood production. The combination of this opportunity and other current events, such as the state budget gap, ocean acidification, climate change and otter predation, has inspired stakeholders to take a fresh look at the development of mariculture utilizing a more comprehensive approach.

In 2014, AFDF received a grant from the National Oceanic and Atmospheric Administration (NOAA) for AFDF's Alaska Mariculture Initiative – an effort to accelerate the development of mariculture in Alaska with the vision to grow a $1 billion industry in 30 years. As a result of the Initiative, Governor Walker established the Alaska Mariculture Task Force (Task Force or MTF) in 2016 by Administrative Order #280 (see Appendix A). AO#280 details the benefits to Alaskans which could be provided by a fully developed mariculture industry:

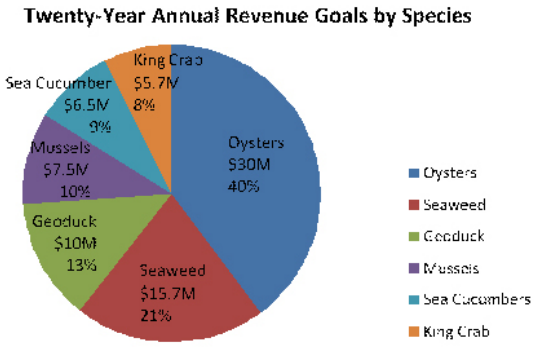
- Economic – provides jobs and commerce in coastal communities:
- Environmental – improves the local ecosystem in various ways, such as providing habitat improvement, carbon removal, or countering ocean acidification;
- Cultural – is compatible with traditions, cultures, and skills in rural communities;
- Industrial – complements and expands our existing renewable seafood industry, which is Alaska's largest private sector employer;
- Food Security – increases access to local foods for Alaskans.

The Task Force is comprised of 11 representatives of various stakeholders, including communities, tribes, industry, hatcheries, the University, and two state departments (Commerce, Fish and Game). The Task Force was directed by the Governor to create a comprehensive plan for the development of a viable and sustainable mariculture industry producing shellfish and aquatic plants for the long-term benefit of Alaska's economy, environment and communities. This document is a result of that comprehensive planning process by the MTF.

A part of the comprehensive planning process has included dozens of public meetings of not only the Task Force, but also five additional Advisory Committees in the following topic areas: Investment and Infrastructure, Research and Development, Regulatory Issues, Public Education and Marketing, and Workforce Development (see Appendix B, C, and D). All information related to meetings of the Task Force is available at the Task Force's website*.

Another part of the planning process included a phased economic analysis to inform the development of the comprehensive plan. The first phase of the economic analysis involved a set of case studies of other regions with successful mariculture industries and relevance to Alaska in terms of species, regulatory structure, etc. These case studies found six key elements for successful mariculture development, which included: 1) pre-existing seafood industry infrastructure, 2) public acceptance and support, 3) favorable growing areas, 4) development plan with coordinated research and development strategy, 5) successful business plans and growing technology, 6) workforce development (see Appendix D).

The second phase of the economic analysis provided an economic framework for the development of a $100 million mariculture industry in 20 years (total annual output, without adjustment for inflation). This framework included the following six species currently under some level of research and development in Alaska and annual revenue goals in 20 years: oysters ($30M), geoducks ($10M), seaweeds ($15.7M), mussels ($7.5M), sea cucumbers ($6.5M), and King crab ($5.7M). 30-Year output associated with goals in this economic framework is projected at $274 million, while 50-Year output totals $571 million (see Appendix E).




Pairing mariculture development with existing seafood industry infrastructure and expertise (e.g. vessels, processing plants, workforce, seafood markets, and hatcheries) is also likely to provide a successful platform from which to grow and expand the mariculture industry in Alaska. Additionally, small farms in Alaska have struggled for the past 30 years to provide the economies of scale necessary to pay for and support the shellfish hatchery infrastructure required. The addition of more participants, some of which are medium or larger-scale, will help support and stabilize the shellfish hatcheries and provide for other synergies and efficiencies to the benefit of smaller-scale participants as well.

A healthy and fully developed mariculture industry is likely to include small, medium and large farm sizes, and may also include a variety of business models for the interaction of participants and specialization of work related to the industry. One of the key findings of the "Alaska Shellfish Farm Size Feasibility Study", published by the

*http://www.adfg.alaska.gov/index.cfm?adfg=amtf.main

Alaska Department of Commerce in 2015, showed that larger farm sizes would result in better economic feasibility of farm businesses: "Regardless of farm type, larger farm size scenarios demonstrated better short and long term profitability than smaller farm sizes...new entrants into the Alaska shellfish farming industry should consider investments in medium and large scale farms".

Alaska has a number of successful examples of resource development for the benefit of Alaskans from which to draw for guiding mariculture development. Alaska's salmon industry is a great example of how small, medium and large-scale participants have developed beneficial working relationships in order to harvest, process, develop new products, market and sell hundreds of millions of pounds of Alaska salmon every year. Alaska's salmon fishery enhancement program is another example of a successful integration of sustainable resource management practices for the long-term benefit of public and private interests.

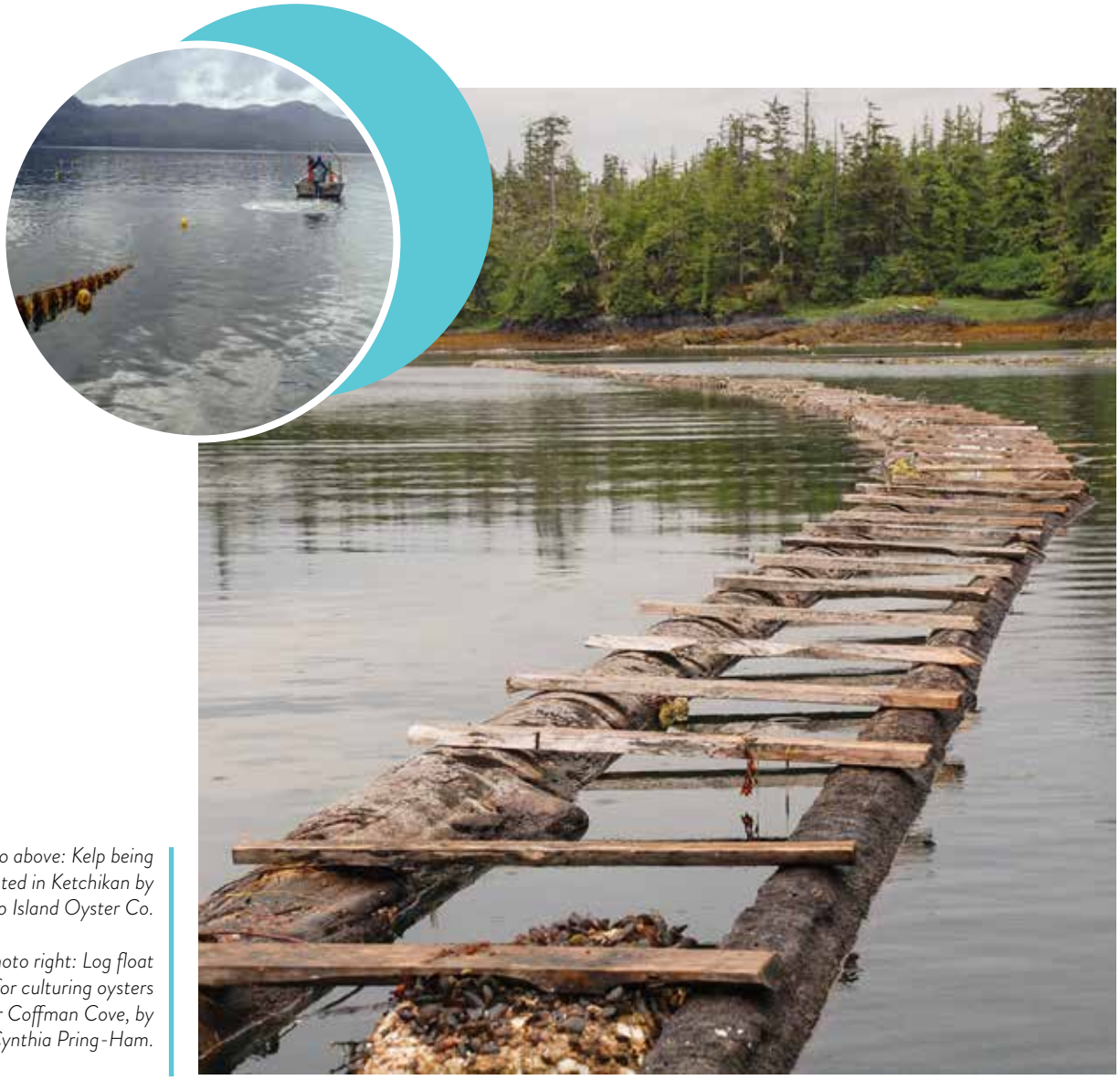


*Photo above: Kelp being harvested in Ketchikan by Hump Island Oyster Co.*

*Photo right: Log float for culturing oysters near Coffman Cove, by Cynthia Pring-Ham.*

# A PLAN FOR ACTION

The Mariculture Task Force determined the following sections to be the priority elements for this comprehensive plan to develop the mariculture industry to its full potential. Each section discusses an element in general terms and also provides recommendations for actions. The full set of recommendations with detailed descriptions from the five Advisory Committees are included in Appendix E, and the Research and Development AC recommendations are expanded upon in the applied research section and in Appendix H. The priority recommendations are highlighted **in blue** throughout the elements and also summarized at the end of the elements.

## • Secure Seed Supply Through Hatcheries

Shellfish and seaweed hatcheries are an integral piece of infrastructure required for any mariculture development. Several of the Task Force Advisory Committees identified adequate support for hatcheries at the early stages of development as one of the top priorities. Hatcheries can be independent entities that serve a variety of customers, such as small and medium-sized farms, and fishery enhancement or restoration programs. Hatcheries can also be vertically integrated within larger farm businesses. However, new farm entrants are most likely to limit their initial risks by purchasing seed from an existing hatchery. Without adequate quality, quantity and consistency of seed or juvenile production, the mariculture industry will not thrive. In comparison to other regions, Alaska has additional requirements regarding the use of local broodstock and seed production in state in order to address genetic concerns (oysters being the only exception). These requirements are a part of ADF&G's precautionary principles that help to ensure the long-term sustainability of the resources. However, in the short-term, they add additional cost and constraints to seed and juvenile production.

*Oyster spat at shellfish hatchery, by OceansAlaska*

It is in the public's interest to support the development of the industry through short-term financial support of hatcheries with the eventual goal of self-sufficiency. This can be accomplished by aligning state, federal or private resources. (e.g. public/private partnerships, such as the models for the salmon enhancement program, seafood marketing or regional seafood development associations (RSDAs), sport fish restoration funds, or AIDEA partnerships)

***Mariculture Task force recommendations include:***

- **Secure seed supply through direct funding for hatchery operating costs in the short term until the industry grows to a size that is self-sustaining.** Develop additional long-term funding options available to support hatchery production.
- **Amend the Mariculture Revolving Loan Fund to allow and encourage shellfish and seaweed hatcheries to utilize the fund.**
- Increase the principle of the Fund as utilization increases with the development of the industry.
- Provide technical assistance to existing and new hatcheries. As ocean conditions change, hatcheries play a role in monitoring these changes and can help identify suitable adaptations. Technical assistance will allow hatchery staff to adjust hatchery procedures quickly to overcome continually changing circumstances.

## Establish an Alaska Mariculture Development Council

In order to accelerate the development of the industry, coordination is necessary across stakeholder groups and across multiple elements needed to develop the mariculture industry. Several MTF Advisory Committees (ACs) identified lack of coordination as a systemic problem. The Task Force agreed, and considers creating an entity responsible for coordination one of the top priorities. The coordinating entity should be composed of a broad spectrum of stakeholders, be industry-driven and be given a charge to coordinate all aspects of mariculture development in Alaska, including coordination with recommended future key personnel (i.e. NOAA Aquaculture Coordinator in Alaska, Alaska Sea Grant Mariculture Specialist, and Mariculture Research Center Director).

A number of models exist (i.e. AKCRRAB, MTF, ASGA, Board of Fisheries, ASMI, etc.) with varying authority, capacity and scope. Additional discussion is expected to determine the best approach to selecting, staffing, and housing this entity.

***Mariculture Task force recommendations include:***

- **Establish an Alaska Mariculture Development Council (AMDC) beginning with the extension of the MTF and its ACs for three years with a new directive to begin implementation of the comprehensive plan and to work towards creation of the AMDC.**

*Sugar kelp at farm site, by Blue Evolution.*

## Maximize Innovation and Growth through Research

Research can solve practical problems and contribute new knowledge, processes, technology and ideas to Alaska's growing mariculture industry. Partnering with farmers, hatcheries and other stakeholders in applied research is critical to the growth of the industry and to ensure the wise use of research dollars. Application of research results then requires demonstration to scale up to industry levels. The Task Force recommends supporting collaborative research with industry application.

The Task Force's Research and Development Advisory Committee identified an extensive list of applied research that would support development of the mariculture industry in Alaska. The Task Force endorses the near, mid and long-term research priorities described in the applied research section, and Appendices E and H.

Applied research in mariculture is happening around the world and the MTF encourages the development of active partnerships and monitoring relevant progress for potential application in Alaska. However, Alaska does not yet have the capacity to coordinate, direct and engage industry in research priorities effectively and has limited capacity to share and demonstrate applied research results. The Advisory Committee recognized this as a systemic barrier to development of the industry.

***Mariculture Task force recommendations include:***

- **Establish and staff a Mariculture Research Center within the University of Alaska with an Industry Advisory Body to coordinate and develop partnerships to address research priorities and continually update needs.**
- **Fill the Alaska Sea Grant Mariculture Specialist position within UAF to ensure engagement with, and application of research to, mariculture businesses.**
- **Fill the NOAA Aquaculture Coordinator position in the Alaska Region in order to facilitate coordination of research and growth of the industry.**

## Align Laws, Regulations and Agency Practices with Stakeholder Needs

Most tidelands and submerged lands within Alaska's coastline are common property and are managed using multiple use principles and sustained yield requirements. The Alaska Constitution requires resource decisions to be vetted through a public process to balance resource management decisions with the best interests of the people of the State of Alaska, and remain consistent with sustained yield principles. The statewide mariculture program is jointly administered by three state agencies.

The Alaska Department of Natural Resources (ADNR) authorizes the use of tideland and submerged land and seeks to balance use of the land for the development of aquatic farming with traditional uses of the area, upland owner access, public access, and navigation of public waters.

The Alaska Department of Fish and Game (ADFG) issues permits for the operation of aquatic farms and hatcheries, acquisition and transport of stock and seed, and ensures aquatic farming does not significantly affect existing uses of resources, or fish, wildlife or their habitats in an adverse manner.

The Alaska Department of Environmental Conservation (ADEC) is the Alaska Shellfish Sanitation Authority with regard to protecting human health while allowing for commercial sales of molluscan shellfish and also allows for oversight of processed seafood. As such, ADEC must demonstrate that it meets all requirements of the National Shellfish Sanitation Program (NSSP) in order to maintain

its membership in the Interstate Shellfish Sanitation Conference (ISSC). The US Food and Drug Administration (FDA) evaluates Alaska's program, determining Alaska's conformance with national standards for water quality of harvest areas, marine biotoxin controls, physical plant sanitation, harvest and handling practices, and control of harvest (patrol and enforcement). Alaska's commercial industry can ship outside of Alaska only if Alaska demonstrates conformance with the national sanitation program.

At times, agency responsibilities to protect common property resources and human health have resulted in an atmosphere perceived as being in opposition to development of the mariculture industry. For growth to occur, it will be incumbent upon both industry and agencies to work together to promote the development of mariculture in a manner that is compatible with the prescribed responsibilities. This will include enacting recommended legislation, modification of some regulations and policies, and leadership that provides direction towards accommodating mariculture projects while still ensuring protection of common use, human health, and sustained yield of natural resources.

*Mussel culture rafts with predator exclusion panel in Halibut Cove, by Cynthia Pring-Ham.*

In addition, current agency staffing levels are unlikely to absorb additional workload at the pace that a fast growing industry demands. More resources will be necessary. However, this growth will contribute to the economy and provide revenue to the state to support these needs.

***Mariculture Task force recommendations include:***

- **Enact legislation to allow restoration, rehabilitation, and enhancement of shellfish stocks.** These activities are currently not authorized in Alaska, therefore the only legal form of mariculture at this time is aquatic farming.
- Create a single point of contact housed in the Alaska Mariculture Development Council to assist applicants with state and federal permitting in state waters. A wide array of permits is required, each with individual permitting processes that an applicant for a mariculture farm or project must navigate. Most agencies do not know what permitting is required by other agencies and it is not within their legal purview to assist with those. Applicants will benefit from a single point of contact for all permit applications and instructions, as well as assistance in navigating the diverse permitting processes.
- Modify DNR farm site lease requirements, including bonding requirements, structure of lease fees, reduction of risk, and inclusion of best practices. These are often the most challenging aspect of aquatic farming, especially new farmers not selling product yet. Adjustments through legislation or regulatory amendments to reduce the cost burden commensurate with farmer qualifications/ circumstances would be beneficial (see detailed recommendations in Appendix E).
- Provide the resources necessary to ADEC to maintain access to commercial markets for Alaska shellfish and protect human health. In order for industry to sell molluscan shellfish, ADEC must meet NSSP requirements, provide biotoxin and water quality testing services, and address public health challenges such as Vibrio parahaemolyticus (Vp). Limited staff capacity and funding currently hinders ADEC from implementing these federal requirements and effectively advocating for Alaska's unique attributes which require federal regulatory exceptions. Additionally, very little research has been conducted in Alaska to monitor for Vp and biotoxins to verify that controls remain effective in preventing illness.
- Pursue clarification of current interpretations of regulations related to interactions between aquatic farming activities and marine mammals, and identify potential mitigations to allow increased area to be eligible for aquatic farming (e.g. existing interpretations restrict aquatic farming within 1 nautical mile of all seal areas of high-use).

## • Secure and Promote Investment in Mariculture

Securing adequate capital to support mariculture operations remains a challenge for many interested developers in Alaska. While a diverse framework of funding mechanisms exists in the form of various loan and grant programs, the eligibility requirements, terms, funding caps and general complexities have created barriers for new operators, resulting in underutilization of these programs. Further challenges in securing financing are operational scale, species, risk, lack of operating history, access to collateral, the level of understanding and awareness of various funding options and the limited scope of Alaska's young mariculture industry.

At this early stage, mariculture is a relatively high-risk investment due to the unique characteristics of mariculture operations, including the relatively long grow-out periods of some species, learning curves associated with new operational techniques and the time needed to develop markets. While the MTF recognizes the need for continued and increased private investment, the developing industry needs the continued support and investment from public resources. Previous investment in the industry has started providing returns to Alaska, attracting interest from private investors and federal funding agencies.

While Alaska's mariculture industry will require new investment in infrastructure, there are significant challenges and costs associated with development and operating that are unique to rural coastal Alaska and can be exacerbated for small scale operators, such as high transportation and energy costs, limited workforce and minimal support services. Alaska's seafood processors have had to overcome these challenges and some have expressed interest in diversifying their operations through mariculture development, which could lend well to partnership opportunities.

*Photo above: Fish processing plant in Atka, by Mike Vickers.*

*Photo left: OceansAlaska floating shellfish hatchery in Ketchikan, by OceansAlaska.*

Marketing of mariculture opportunities to the seafood industry itself will be an important part of development. The Task Force recommends further coordination to inform existing processing plant owners of potential business diversification opportunities, and to foster relationships between mariculture and traditional seafood participants in the harvesting and processing sectors.

*Alutiiq Pride Shellfish Hatchery in Seward, by Alutiiq Pride.*

Attracting a diverse range of private investment within and outside of Alaska will be key for the industry to reach a scale where it can support viable hatcheries, nurseries and growers. This will likely mean additional small, medium and large-scale development in the state. Protecting the existing and future participation of small and community-scale mariculture operators is of critical importance to stakeholders. As the industry continues to grow, regulators, stakeholders and coastal communities should continue to engage in discussions regarding their vision for the industry, and ways that small, medium and large-scale developers can leverage resources, share information and access capital.

Recent agency cuts due to the State's reduction in oil revenues have hampered agency responsiveness to farm applications and ability of staff to address developmental challenges. As the industry grows, agency staffing needs will increase. However, revenues paid to the state by industry will also increase. Adequate staffing during developmental stages is important to enable accelerated industry growth.

The Task Force recommendations in Appendix E target increasing access to capital and resources for existing and prospective participants in the mariculture industry.

***Mariculture Task force recommendations include:***

- **Increase the principal of the Mariculture Revolving Loan Fund as utilization increases with the development of the industry.**
- **Encourage private investment in mariculture from within Alaska and outside Alaska.**
- **Coordinate and align existing federal and state funding sources for more efficient development of the industry.**
- **Explore the development of new funding sources and structures focused at providing assistance with business planning and start-up costs for both farming and enhancement.**
- **Develop partnerships to leverage utilization of existing coastal infrastructure.**
- **Develop an interactive web-based map tool, housed with the State or NOAA, to help inform business planning, site selection and regulatory review.**
- **Provide adequate financial support for state agencies to properly manage and timely process new or modified farm applications.**
- **Develop options and support for self-assessments, taxation or other fee mechanisms which support growth in both state and industry capacity.**

## • Build Public Understanding and Support for Mariculture

One of the key elements of developing mariculture in Alaska is building public understanding of, and support for, mariculture. No amount of public and private investment can result in project implementation and success without the support of the affected public and the subsequent political approval. Of particular importance is providing information that emphasizes public and private commitment to maintaining both environmental integrity and existing traditional resource uses.

Mariculture proponents and producers should provide public outreach to multiple audiences to help assure realistic and positive views of mariculture development. This effort is a short and long-term need, recognizing and addressing existing negative attitudes about mariculture. These concerns include perceived environmental damage or genetic changes, concerns for aesthetics, market competition with wild-caught seafood, and conflict with existing users. Research into factual information in these areas can form the basis for information to reassure concerned members of the affected communities and the wider public.

Inclusion of all stakeholders and community members, Alaska youth, Alaska Native users and commercial fishing interests at the beginning of conversations about mariculture will go a long way toward allaying fears and concerns. The Task Force recommends identification of priority groups, and development of outreach and communication with each. Working with affected entities should be an integral part of the permitting process.

*Original AKCRRAB steering committee members Gale Vick and Brian Allee hold a red king crab female used for brood-stock, by Celeste Leroux.*

As developing and providing sources of important facts on an ongoing basis is an important element of mariculture development, it is crucial to identify the appropriate entities to gather and disseminate such information, and to provide advocacy for the growing industry. Some existing entities currently perform parts of these functions: the Alaska Sea Grant program with its extensive online library of mariculture information, the Alaska Fisheries Development Foundation (AFDF), the Alaska King Crab Research, Rehabilitation and Biology (AKCRRAB) program, the Alaska Shellfish Growers Association, the Pacific Shellfish Institute, the Pacific Coast Shellfish Growers Association, Kachemak Shellfish Mariculture Association, ADF&G, NOAA and Alaska Pacific University. In the future, coordination of advocacy and information functions should be integral to development plans.

In addition, information gathered by agencies related to the public health (i.e. water quality and PSP) should be made publicly available on a website managed by ADEC.

***Mariculture Task force recommendations include:***

- **Provide public outreach to multiple audiences to promote mariculture development.**
- **Prepare and emphasize information about maintaining existing uses, preserving the environment, preventing genetic issues and avoiding market competition with wild-caught seafood.**
- **Identify and communicate with all community stakeholders early in the process.**
- **Coordinate information and advocacy through a central body.**

## Promote Success through Alaska Native participation

Mariculture development will benefit from the participation of Alaska Natives in every element of the process, utilizing local and traditional knowledge in the siting of farms, accessing programs and funding sources geared towards economic and workforce development, and supporting appropriate development on Native-owned lands.

***Mariculture Task force recommendations include:***

- Provide outreach to Alaska Native organizations related to mariculture opportunities and relevant technical and financial support.
- Seek tribal engagement through local outreach during the farm permitting process to increase success for new farms.
- Establish collaborative workforce development programs between tribes, Alaska Native Corporations, industry and other relevant partners.
- Integrate mariculture topics and studies in relevant educational programs.

*Photo left: The beach crew at Hobart Bay celebrates the completion of geoduck plantings in 2014; project sponsored by Goldbelt Inc, provided by Peter Metcalfe.*

*Photo above: Anthony Lindoff, owner of Kaawu Oyster Company in Hoonah, by Bob Koenitzer, McDowell Group.*

## Grow and Develop the Mariculture Workforce

Self-employed owners and family members currently make up the bulk of the workforce at mariculture farms in Alaska. Hatchery and nursery operations generally employ full-time and/or seasonal employees. Farmers and hatchery operators identify workforce needs as an ongoing challenge.

Impediments to meeting workforce needs include: remote farm locations, short seasons, physically demanding and repetitive work, outdoor work in inclement weather, and relatively low wages. Targeting key populations of Alaskans habituated to weather and remote conditions, such as fishermen, tribal members, veterans and rural youth is one strategy to meet workforce needs. Incentives and workforce development programs may encourage more Alaskans to follow this career pathway.

*Oyster farm workers on Prince of Wales Island, by Blue Starr Oyster Company.*

Training and professional development is critical to recruiting a quality workforce and ensuring self-employed farmers gain the most value from their businesses. However, no required certification or degree is needed to operate a mariculture farm in Alaska. Hatchery workers may have some level of post-secondary education, although that requirement is not consistent across the state. Thus, the best training and professional development is often via short-courses available onsite or via distance delivery, focusing on operational and business needs of Alaska mariculture farms and hatcheries.

***Mariculture Task force recommendations include:***

- **Develop mariculture skill-building resources and provide professional development opportunities to growers, available both remotely and in-person.**
- **Offer an intensive, hands-on "Introduction to Shellfish/Seaweed Farming" boot camp in partnership with industry, tribes, educators and other stakeholders.**
- **Utilize the University of Alaska's Sea Grant Mariculture Specialist position (currently vacant) to implement these recommendations. Develop a mariculture apprenticeship/mentorship program.**
- **Participate in industry career awareness activities.**
- **Evaluate and track participant progress and include mariculture workforce impacts in economic and employment analyses.**

## Develop New Mariculture Markets and Products

As mariculture of shellfish and aquatic plants grows in Alaska, marketing research and development, as well as product development, will help assure that increased production results in increased opportunity and stable revenue for the industry and the State.

Wild-caught seafood produced in Alaska is marketed by individual processing and distribution companies, and in a species-based program through the Alaska Seafood Marketing Institute (ASMI). Processors pay ASMI a self-imposed tax as a percentage of the value of the seafood products, and the State and Federal governments have contributed funding as well. The revenues are used for domestic and foreign food

service and retail marketing campaigns.

If Alaska mariculture-produced shellfish and aquatic plants are to benefit from the world-class ASMI marketing program, producers will need to contribute to ASMI funding through self-imposed contributions. If mariculture producers become part of the ASMI funding stream, ASMI could be encouraged to revise its strategic plan and advertising taglines to include mariculture products, shifting "wild" messaging to the more inclusive "Alaska Grown" or "Alaska Pure."

*Alaska oysters, photo provided by Alaska Seafood.*

Part of the effort should include increased collaboration between ASMI and the existing Alaska Grown program, creating a synergy with a larger group of Alaska Food Producers.

In developing the public's awareness and acceptance of mariculture products, public education and marketing intersect. Public information about mariculture's economic and environmental benefits helps create a positive perception of a wide range of mariculture products. In turn, mariculture product marketing should include general education about mariculture at every level, similar to the current inclusion of sustainability in wild seafood marketing.

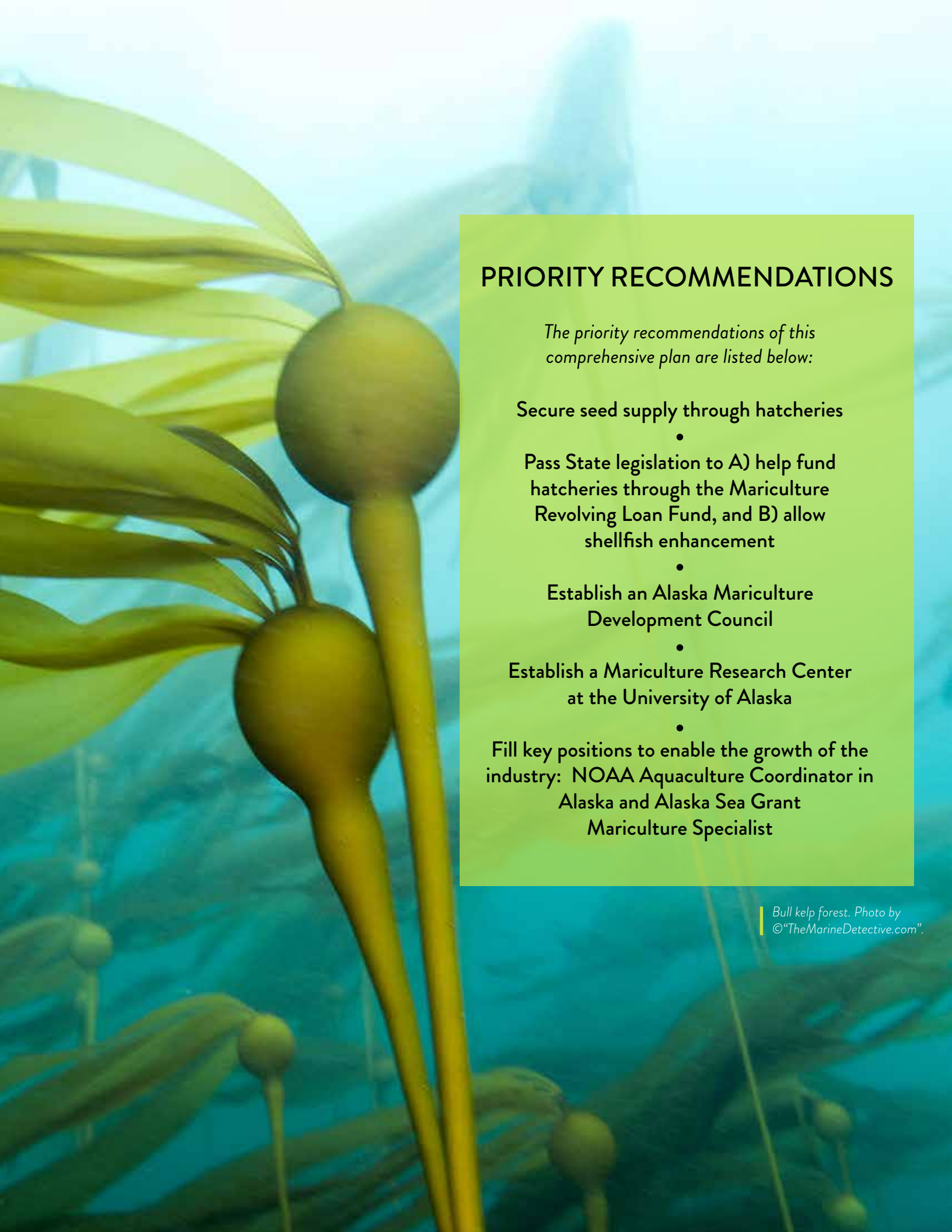
Research and development of new product forms and new market opportunities will also be needed, as detailed by the Research and Development Advisory Committee in Appendices E and H.. A dedicated Alaska Sea Grant Mariculture Specialist, as well as Federal focus and funding for mariculture will contribute to these efforts.

For oysters, research and develop value added products aimed at export markets; for mussels, develop frozen product form and other value added products and methods to compete in the world market; for sugar and ribbon kelp, develop international markets and product stabilization. New products for either frozen or dried products may make additional farm sites economically feasible due to lower cost of transportation and other factors

In addition, the developing industry has a great need for economic data collection and research, to help determine the financial viability of shellfish and aquatic plant operations, as described in the Research and Development section.

***Mariculture Task Force recommendations include:***

- **Coordinate mariculture marketing efforts through trade associations and consider joining with ASMI through self-assessment.**
- **Encourage ASMI to expand marketing range to include mariculture products.**
- **Engage in product form research and development and market research.**
- **Support economic data collection and research.**



## PRIORITY RECOMMENDATIONS

*The priority recommendations of this comprehensive plan are listed below:*

Secure seed supply through hatcheries

•

Pass State legislation to A) help fund hatcheries through the Mariculture Revolving Loan Fund, and B) allow shellfish enhancement

•

Establish an Alaska Mariculture Development Council

•

Establish a Mariculture Research Center at the University of Alaska

•

Fill key positions to enable the growth of the industry: NOAA Aquaculture Coordinator in Alaska and Alaska Sea Grant Mariculture Specialist

*Bull kelp forest. Photo by ©"TheMarineDetective.com".*

# APPLIED RESEARCH

In recognition of the important role that applied research can play in supporting the development of any industry, the Mariculture Task Force is highlighting the following two sections. The first section outlines a strategy which includes six components and integrates researchers with stakeholders to further develop Alaska's mariculture industry. The second section summarizes the near-term research priorities as identified by the Research and Development Advisory Committee. More extensive information regarding near, mid and long-term research priorities is also included in Appendices E and H.

## A Strategy to Meet Research Needs

The University of Alaska needs a cohesive, coordinated and focused approach to supporting mariculture in Alaska. No undergraduate or graduate major or minor in mariculture currently exists, with limited participation by faculty and students in the field. However, the University has significant capabilities in marine sciences, fisheries and oceanography, seafood technology, engineering, food sciences, and research on commercially important fish, mollusks, crustaceans, and aquatic plants.

Alaska needs the capacity to coordinate, direct and engage industry in effectively developing research priorities, and in sharing and demonstrating applied research results. The Research and Development Advisory Committee recognized this as a systemic barrier to development of the mariculture industry. The Advisory Committee and the Mariculture Task Force proposed the following strategy to address the near and long-term research and development needs of the Alaska mariculture industry.

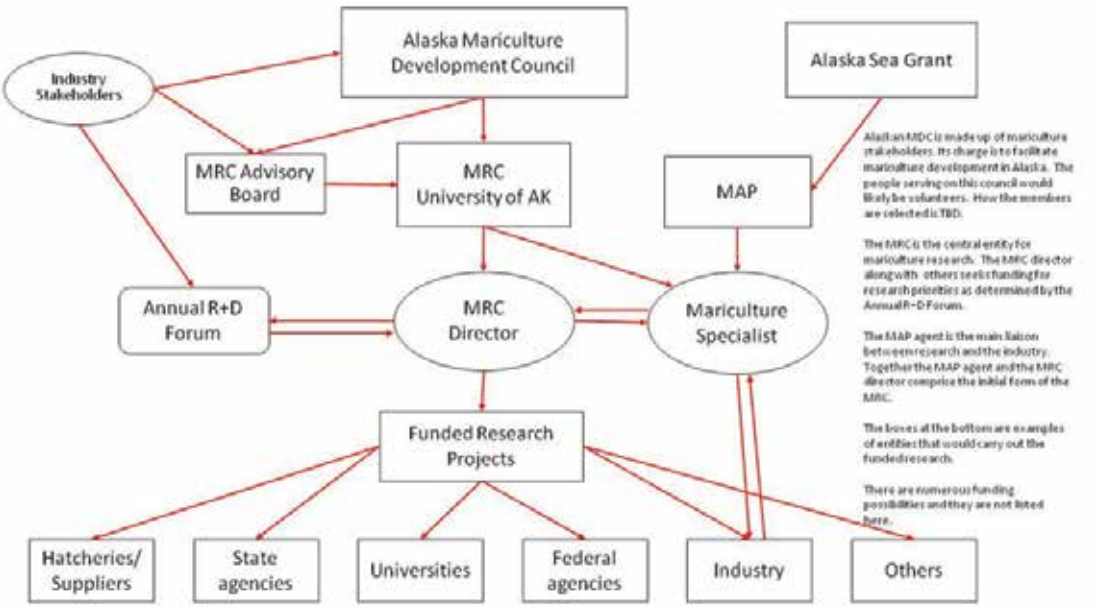



*Diagram 1 - A Strategy to Meet Research Needs*

The **Alaska Mariculture Development Council** (AMDC) would be composed of representatives from government agencies, industry groups, economic development agencies, the university, and other stakeholders to facilitate mariculture development goals. The AMDC would facilitate all aspects of mariculture including research and development, regulations, workforce training, education, marketing, etc. For research and development, the AMDC would coordinate with the Mariculture Research Center staff.

The establishment of a **Mariculture Research Center** (MRC) housed in the University of Alaska would ideally have two key personnel. One position would be the Director of the MRC and would need to be a PhD level new hire (who could be an invertebrate physiologist/culturist) who could translate industry needs into research projects in a variety of fields from biology, to food sciences, to engineering. The Director would also host an annual **Mariculture R+D Forum**, where growers and researchers would interact to decide on research priorities and turn these priorities into projects, teams, grant proposals, funded research and outcomes. The Director will also write grant proposals to bring in funding from NOAA (mariculture program, SK program, Sea Grant), National Science Foundation, USDA, Economic Development Administration, Small Business Innovative Research and others.

**The MRC Advisory Board** would involve industry members in setting priorities and guiding projects.

The University of Alaska MRC would also need a mariculture extension agent to work on applied research projects with growers, take the results from projects to the field, and interact with other stakeholders. This person could be housed under Alaska Sea Grant's Marine Advisory Program, and would be an integral part of the MRC and ideally co-located with the MRC Director.

Funding for the MRC staff and support staff should be via "hard" money with a long-term commitment. Initial funding would be necessary for salaries for the MRC Director, extension agent and an administrative assistant, plus funding for travel and for the initial Mariculture R+D Forum.

The staff of the MRC could build a core competency in the University system, eventually resulting in mariculture minor, major, and graduate degree programs. Combined with the guidance of the AMDC and the outcomes of the annual Mariculture R+D Forum, the MRC would bring together industry, university, state, Alaska Native and other groups in Alaska, and a network of cooperators and cooperating facilities, giving the required support to accelerate and fully develop the mariculture industry in Alaska.

In addition to the Alaska Mariculture Development Council and the Mariculture Research Center, Alaska needs:

- **Lead government agency** – within both the state and federal governments, a lead agency with a single point of contact is necessary to streamline and facilitate responsive permitting.
- **Mariculture R+D Forum** – an annual forum where research priorities are set with strong industry input, and action plans are developed to achieve outcomes.
- **Funding** - to facilitate mariculture industry development by supporting applied research determined as necessary during the annual Mariculture R+D Forum. This will be inclusive of federal, state, private and non-profit funding sources and people and facilities needed to implement the research.
- **Network of facilities** – these existing facilities are capable of doing mariculture research and development as part of their mission statements, including the NOAA Kodiak Lab, Juneau UAS Lab, Juneau NOAA Lab, UAF-CFOS, Kasitsna Bay Laboratory, APSH, OceansAlaska, Alaska Sea Life Center, Sitka Sound Science Center , Kodiak Seafood and Marine Science Center and others. The Mariculture Research Center director pulls together available resources like these ("Alaska Mariculture Network") to assist in meeting the research priorities.

*Sea cucumber juvenile survival research completed by Charlotte Regula-Whitefield, by SARDFA.*

## A Summary of Near-Term Research Needs

Near-term priorities are defined as priorities for species of immediate interest (1-2 years) for mariculture in Alaska along with specific issues that need to be addressed to create a viable commercial enterprise for each species. For an overview of the near, intermediate, and long-term priorities for mariculture in Alaska, see **Appendix H - Completed Research and Future Research Needs**. The lists were prepared by the Research and Development Advisory Committee.

**I. Near-term research priorities for shellfish farming in Alaska**

*Oysters, Pacific*

1. Research focused on oyster spawning in Alaska
2. Research focused on oyster larvae setting and growth to nursery size in Alaska.
3. Research focused on oyster nursery stage
4. Research focused on oyster farms and shellfish processing.

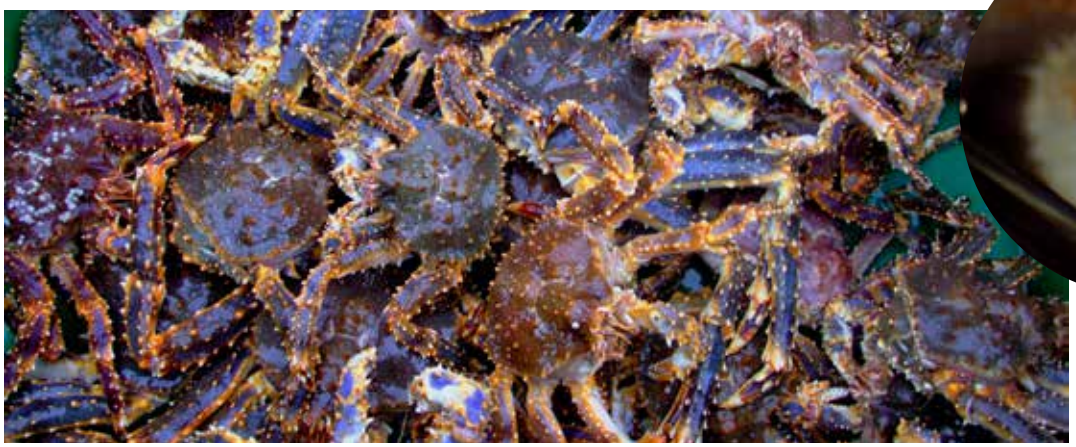
*Mussels, Blue*

1. Identify genetic and disease issues that prohibit/inhibit the growing of blue mussels to market size in Southeast Alaska. **High**
2. Continue research on production technology.
3. Develop frozen product form and other value added products and methods.
4. Develop improvements in production and processing methods to increase throughput.

**II. Near-term research priorities for shellfish enhancement in Alaska**

*King crab (Paralithodes camtschaticus; Paralithodes platypus)* (priorities developed by the Alaska King Crab Research Rehabilitation and Biology Program)

1. Refine rearing protocols for red and blue king crab by:
2. Understand the behavioral, morphological, and physiological differences between hatchery-reared and wild juvenile king crab and potential competitive interactions.
3. Determine optimal nursery habitats to maximize growth and survival of juvenile king crab in both the hatchery and once outplanted.
4. Assess likelihood of outplanting success based on biological and environmental interactions.
5. Investigate fate of hatchery-produced juvenile king crab during release experiments.
6. Project operational costs for producing juvenile red and blue king crab for enhancing depressed wild crab stocks, including hatchery, nursery, and stocking phases.
7. Determine funding mechanisms and identify any potential changes in state law and regulations necessary to allow crab harvesters and/or coastal communities to conduct king crab rehabilitation activities.
8. Work with potential user groups to develop preliminary collaborations with community and/or industry groups interested in forming rehabilitation associations.



*Above: Juvenile King Crab, by Celeste Leroux.*

*Left: Blue King Crabs, by Celeste Leroux.*

**III. Near-term research priorities for seaweed mariculture in Alaska**

*Saccharina latissima* (sugar kelp) and *Alaria marginata* (ribbon kelp)

1. Research the population genetics of seaweeds of current and future commercial importance in order to better understand how seaweed farms might affect the natural populations.
2. Research to determine the best practices for obtaining parent plants for seed production.
3. Research on strain selection.
4. Market and product research for sugar and ribbon kelp
5. Research on hatchery optimization for large scale production of seeded string
6. Research needed on optimal timing of outplanting and harvest (at different sites in Alaska).
7. Research on the optimal conditions for growth (depth of outplant, nutrients, temperature, light, salinity, current).
8. Site selection research.
9. Oceanographic monitoring at existing growing sites, including nitrogen, phosphate, salinity, temperature, turbidity and currents.

**IV. Near-term research priorities for new species mariculture in Alaska**

General

1. Begin the process to identify new species that present potential economic opportunity in Alaska based on previous studies or successful mariculture in other regions.

**V. Near-term research priorities for environmental data collection to support mariculture in Alaska**

*Bivalves and public health issues*

1. Rigorously research and develop methods to monitor and mitigate Vibrio P. occurrences.
2. Research and develop methods to mitigate harvest disruptions due to wild animal fecal coliform in remote areas.
3. Develop public platform to access Paralytic Shellfish Poisoning (PSP) data.
4. Research and develop low cost PSP testing methods.
5. Identify appropriate regions to increase spatial extent of PSP testing (e.g. Kodiak Island) to address potential for underdeveloped opportunities for shellfish farms.
6. Develop a data base of the occurrence of PSP and causation in Alaskan waters.

*Site selection*

1. Develop prioritized physical and biological data collection necessary for site selection by species (bivalve, crab, seaweed) or method (farm, enhancement) of interest. This would include information to avoid areas with PSP, large wildlife populations, anadromous streams, higher freshwater influx etc.
2. Do basic oceanography studies of existing growing areas in cooperation with the farmers to understand biophysical factors contributing to shellfish growth rates and meat yields.
3. Identify and support research to assess mechanism of PSP loading (cyst density) in different species (e.g. oysters, geoducks).

*Site specific measurements*

1. Develop prioritized physical and biological data collection necessary for site operation by species (bivalve, crab, seaweed) or method (farm, enhancement) of interest.
2. Develop an active list of what is currently being monitored at each site and work with regional groups (e.g. AOOS) to host the database and website for public data access.

*Photo above: adult geoduck at a hatchery for spawning in Seward, by Cynthia Pring-Ham.*

*Regional measurements*

1. Develop prioritized physical and biological data collection necessary to provide regional and seasonal information to assist with farm or enhancement operations.
2. Identify regional groups (e.g. AOOS) to host a mariculture database and website for access by the farmers and the public.
3. In addition to other physical measurements, develop or maintain carbonate chemistry monitoring in all coastal regions with feasible mariculture opportunities that may be affected by ocean acidification. Locations include:

*A nursery operator checks oyster spat in a FLUPSY in Halibut Cove, by Cynthia Pring-Ham.*

**VI. Near-term research priorities for economic data collection to support mariculture in Alaska**

*General*

1. Development of a web-based break-even analysis planning tool that can be used to explore the effects of farm scale, production intensity, scope, and location on financial viability of shellfish mariculture operations. Includes an analysis of production efficiency related to farm operation and technology.
2. Development of regional and social impact models to highlight the role of aquatic farms in local and regional economies including employment and income impacts.
3. Development of risk management tools to integrate consideration of production risk (survival, growth, etc.) and financial risk (input costs, price volatility, etc.).
4. There is need for research designed to identify strategies for management of production and price risk.
5. Studies to explore role of horizontal and vertical integration or coordination as mechanisms for developing stronger markets, reducing input factor costs, and mitigating risk.
6. Outlook and trends for product prices and demand for Alaskan mariculture products.
7. Economic profile of the existing mariculture industry, including the number of farms, the years of operation, the species grown, farm size, region, etc.
8. Establish goals for industry growth.
9. Investigate existing fisheries infrastructure for possible use in mariculture.

**VII. Near-term research priorities for education to promote regional scale mariculture opportunities in Alaska**

1. Identify educational opportunities in coastal communities
2. Identify and develop workshops on particular mariculture opportunities.
3. Provide training opportunities in multiple aspects of farms or enhancement operations
4. Identify mechanisms for technology transfer to interested entities.
5. Integrate mariculture into STEM education.
6. Investigate possibility of personal use oyster mariculture (gardening), including regulatory issues.

*Photo above: King crab juvenile, by Celeste Leroux.*

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Governor Bill Walker
STATE OF ALASKA

## ADMINISTRATIVE ORDER NO. 280

I, Bill Walker, Governor of the State of Alaska, under the authority of Article III, Sections 1 and 24 of the Constitution of the State of Alaska, and in accordance with AS 44.19.145(c), establish the Alaska Mariculture Task Force.

### FINDINGS

In 1988, Alaska allowed for farming of shellfish and aquatic plants with the enactment of AS 16.40.100 -16.40.199. Since 1988, Alaska's aquatic farming industry has struggled to grow with annual production values through 2013 below $1,000,000.

The potential for increased and sustained economic development from mariculture of shellfish and aquatic plants in coastal communities is significant. Alaska has over 30,000 miles of coastline with clean, pristine, nutrient-rich water. Alaska produces over 50 percent of the seafood of the United States and is a leader in sustainability principles related to its responsible management of these resources. Shellfish and aquatic plants have historically been crucial to the subsistence and livelihoods of many Alaskans. Mariculture also offers the potential to provide resiliency to shellfish resources facing future environmental threats. Industry and policymakers acknowledge the importance of determining what is needed to fully develop this potential into a reality. Shellfish restoration programs are underway in other states and may ultimately be an effective tool to assist in the recovery of depleted wild shellfish stocks in Alaska. Due to ocean acidification and sea otter predation, the resiliency of shellfish resources in Alaska may become even more dependent upon the development of mariculture research, techniques, and enhancement efforts.

Research projects are underway in Alaska with respect to mariculture development. In 2013, NOAA researchers achieved the first experimental release of hatchery-reared red king crab in the state, as a part of the Alaska King Crab Research, Rehabilitation, and Biology Program. The Southeast Alaska Regional Dive Fisheries Association is working with the Alutiiq Pride Shellfish Hatchery to spawn sea cucumbers as a part of ongoing research into production of juveniles.

The farming of aquatic plants could provide diverse social, environmental, and economic benefits for Alaska residents. Aquatic plant culture can produce healthy foods and supplements, increase and preserve habitat for fish and invertebrates, and assist with bioremediation efforts in areas that contain excess carbon loads. Invertebrate culture can also assist with water filtration and removal of excessive nutrient loads.

Alaska's salmon fishery enhancement program offers a model of the potential for mariculture to grow the economy of coastal Alaska while applying sustainable management practices.
The development of the mariculture industry in the state will provide the following benefits to Alaskans:

(1) economic – providing jobs and commerce in coastal communities;
(2) environmental – improving the local ecosystem in various ways, such as habitat improvement, carbon removal, or countering ocean acidification;
(3) cultural – compatible with traditions, cultures, and skills in rural communities;
(5) industrial – complements and expands our existing renewable seafood industry, which is Alaska's largest private sector employer;
(6) food security – increasing access to local foods for Alaskans.

## PURPOSE AND RECOMMENDATIONS

The purpose of this Order is to establish the Alaska Mariculture Task Force (Task Force) to provide recommendations to develop a viable and sustainable mariculture industry producing shellfish and aquatic plants for the long-term benefit of Alaska's economy, environment, and communities.

The Task Force shall present recommendations for a final comprehensive plan for the development of Alaska's mariculture industry to the Governor by March 1, 2018.

The Task Force will use the following guiding principles in the development of its recommendations:

(1) For the purposes of the task force, "mariculture" is defined as enhancement of wild fisheries and aquatic farming of shellfish and aquatic plants. Mariculture does not include finfish farming, which is not legal in Alaska.
(2) The development of the mariculture industry will:
  (A) be compatible with Alaska's reputation as a world leader in responsible and sustainable management of its seafood resources;
  (B) be stakeholder-driven;
  (C) coordinate and integrate with those entities conducting ocean monitoring in order to inform research and management of changing ocean conditions; and
  (D) include analysis of successful models that may be applicable to Alaska.
(3) The comprehensive recommendations of the Task Force shall address, at a minimum:
  (A) public and private investment;
  (B) regulatory issues;
  (C) research and development needs;
  (D) environmental changes;
  (E) public education; and
  (F) workforce development.
(4) The Task Force may establish advisory committees to assist in addressing the previously stated essential elements of the recommendations.

## COMPOSITION AND CHAIR

The Task Force consists of eleven members who are appointed by the Governor and serve at the pleasure of the Governor.

The members of the Alaska Mariculture Task Force shall include the following:

(1) the Commissioner of Fish and Game, or the Commissioner's designee;
(2) the Commissioner of Commerce, Community and Economic Development, or the Commissioner's designee;
(3) a representative from the University of Alaska;
(4) the Director of the Alaska Sea Grant Marine Advisory Program, or the Director's designee;
(5) seven members of the public whose experience may include aquatic farming, seafood harvesting, seafood processing, nonprofit hatcheries, community sustainability, Alaska Native corporations, community development quota groups, tribal governments, or seafood marketing.

A chair and vice chair shall be selected annually by the Task Force from among its membership.

**ADMINISTRATIVE SUPPORT**

The Office of the Governor and the Office of the Lieutenant Governor shall provide necessary administrative support.

**GENERAL PROVISIONS**

Consistent with law and available appropriations, each designated State agency shall use existing personnel and monetary resources to comply with this Order.

Task force members receive no compensation or other remuneration from the State as members of the Task Force.

The Task Force will meet quarterly and may meet more frequently if determined by the Task Force. The Task Force may use teleconferencing or other electronic means, to the extent practicable, in order to gain the widest public participation possible at minimum cost.

Meetings of the Task Force shall be conducted, and notice of regular meetings provided, in accordance with AS 44.62.310 - AS 44.62.319 (Open Meetings Act). A majority of the members of the Task Force constitutes a quorum for conducting business. Records of the task force are subject to inspection and copying as public records under AS 40.25.110 - 40.25.220.

The Alaska Mariculture Task Force expires on June 30, 2018.

This Order takes effect immediately.

Dated at Anchorage, Alaska, this 26 day of February 2016.

Bill Walker
Governor

## List of Members: Alaska Mariculture Task Force

Appointed May, 2016

**Paula Cullenberg** is the director of Alaska Sea Grant, a partnership between NOAA and the University of Alaska Fairbanks. Alaska Sea Grant supports research, student fellowships, K-12 marine education and outreach to coastal communities by Marine Advisory agents across the state. Over the last 10 years, Alaska Sea Grant has invested over $2.5M in mariculture development in Alaska including support for training and research in the shellfish farming industry, and research and technical support for the Alaska King Crab Research and Rehabilitation Program. Currently Alaska Sea Grant Marine Advisory is directing a demonstration project growing seaweed in Alaska's waters as well as new techniques for oyster farmers. Cullenberg has an MS in Fisheries, is a commercial salmon fisherman and has been involved in fisheries development and supporting fishing communities in Alaska for over 30 years.

**Julie Decker**, Vice-chair, is the Executive Director of the Alaska Fisheries Development Foundation (AFDF). Decker has been involved in seafood industry development projects in Alaska for over 20 years. Decker also completed her Master of Public Administration degree, including a concentration in Natural Resource Management, from the University of Alaska Southeast. Decker lives in Wrangell and also commercial fishes with her family on the F/V McCrea.

**Angel Drobnica** works for the CDQ organization, the Aleutian Pribilof Island Community Development Association. Her experience includes working on state and federal fisheries regulatory issues, and energy and food security project development in remote Alaska communities.

**Jeff Hetrick** has been the Director of the Alutiiq Pride Shellfish Hatchery since 2002. Previously he spent 20 years in the salmon enhancement business and has owned and operated an oyster farm in Prince William Sound and has conducted numerous enhancement projects. The Alutiiq Pride Shellfish Hatchery raises blue and red king crab, sea cucumbers, abalone, cockles, butter clams and littleneck clams, razor clams, oysters and geoducks. He has a B.S. and an M.B.A.

**Chris Hladick**, Chair, was the Commissioner of the Alaska Department of Commerce, Community, and Economic Development until November, 2017. He has over 21 years of experience working with communities that have commercial fishing industries, as city manager for the cities of Dillingham and Unalaska. He is now serving as Region 10 Director of the U.S. Environmental Protection Agency.

**Heather McCarty** has been involved in the seafood industry in policy, research, aquaculture, marketing and harvesting for 40 years. On the Mariculture Task Force, McCarty is currently representing the Central Bering Sea Fishermen's Association (CBSFA) related to its interest in the Alaska King Crab Research Rehabilitation and Biology (AKCRRAB) project. McCarty is Co-chair of the AKCRRAB Steering Committee and lives in Juneau.

**Mike Navarre** is the current Commissioner of the Alaska Department of Commerce, Community and Economic Development (ADCCED). As such, he oversees six divisions and seven corporate agencies, and serves on the boards of Alaska Housing Finance Corporation, Alaska Marine Pilots, Alaska Industrial Development and Export Authority, Alaska Energy Authority, Alaska Railroad Corporation, and the Alaska Seafood Marketing Institute. He also serves on the Climate Action for Alaska Leadership Team, as well as the Alaska Mariculture Task Force. Navarre previously served as Mayor of the Kenai Peninsula Borough for the past six years, responsible for managing a $120 million budget. Prior to that, he served in the Alaska House of Representatives from 1985-96 in several roles, including House Majority Leader and Co-Chair of the Finance Committee. Navarre is also involved in the general and financial management of several privately held businesses in Alaska.

**Sam Rabung** is delegated to fill the Alaska Department of Fish & Game Commissioner's seat on the MTF. He has over 35 years experience working in aquaculture programs in Alaska.

**Dr. Michael Stekoll** is Professor of Chemistry and Biochemistry at the University of Alaska Southeast with a joint appointment in the School of Fisheries and Ocean Sciences at the University of Alaska Fairbanks. Dr. Stekoll has over 30 years of research experience on the biology, ecology and mariculture of Alaskan seaweeds. His recent focus is on the mariculture of kelps and sea lettuce.

**Kate Sullivan** is the co-Executive Director of the Southeast Alaska Regional Dive Fisheries Association. Prior to this she was a faculty member in the UA system for ten years. During that time she worked extensively with the aquatic farm industry, providing educational workshops and classes and conducting applied research in collaboration with the farmers. She continues to conduct research on marine bio-toxins and their impact on the shellfish industry in Alaska.

**Chris Whitehead** is the Environmental Program Manager for the Sitka Tribe of Alaska's Resource Protection Department. Chris manages all environmental projects including a harmful algal bloom monitoring program, designing and implementing a regulatory bio-toxin lab, subsistence foods monitoring for heavy metals and mercury, and other climate change related work. He has worked as a researcher developing re-circulating aquaculture systems to rear shrimp and as a shellfish biologist managing commercial crab and geoduck fisheries as well as developing oyster, clam, and geoduck aquaculture farms for local Tribal governments.

**Eric Wyatt** is owner of the Blue Starr Oyster Co., which is located on the outer coast of Prince of Wales Island. Blue Starr grows market oysters and oyster seed for farmers. Eric has worked with a wide variety of mariculture related groups and projects in Alaska, and currently is a board member of the Alaska Shellfish Growers Association and OceansAlaska, a shellfish hatchery.

## Alaska Mariculture Task Force: List of Advisory Committee (AC) Members

Updated 2017-02-19

**1) <u>Investment and Infrastructure</u>**
Chairs: Angel Drobnica and Jeff Hetrick
AC Members: Tomi Marsh, Julie Decker, Erik O'Brien, Jim Gibbons, Trevor Sande, Mark Scheer. Heard from USDA, AIDEA, AK revolving loan fund manager.

**2) <u>Regulatory Issues</u>**
Chair: Sam Rabung
AC Members: Eric Wyatt (ASGA), Jim Aguiar (ASGA), John Kiser (ASGA), Chris Whitehead (Sitka Tribe), Kimberly Stryker (DEC), Adam Smith (DNR), Christianna Colles (DNR), Margo Reveil (ASGA).

**3) <u>Research, Development and Environmental Information</u>**
Chair: Mike Stekoll
AC Members: Jeff Hetrick, Kate Sullivan, Eric Wyatt, Bob Foy, Ginny Eckert, Carter Newell, Keith Criddle, Cynthia Pring-Ham.

**4) <u>Public Education and Marketing</u>**
Chair: Heather McCarty
AC Members: Barbara Blake, Tomi Marsh, Julie Decker, Bobbi Hudson, Paula Cullenberg.

**5) <u>Workforce Development</u>**
Chair: Paula Cullenberg
AC Members: Eric Wyatt, Tomi Marsh, Hope Becker, Reid Brewer, John Kiser, Myrna Gardner, John Fear.

# Alaska Mariculture Task Force
# Advisory Committee Guidance

FINAL November, 2016

Directive to the Alaska Mariculture Task Force (TF) by Administrative Order (AO) #280:

> *"To provide recommendations to develop a viable and sustainable mariculture industry producing shellfish and aquatic plants for the long-term benefit of Alaska's economy, environment and communities."*

The TF has established the following Advisory Committees (ACs) and Chairs:

1) Investment and Infrastructure (Chairs Angel Drobnica and Jeff Hetrick)
2) Regulatory Issues (Chair Sam Rabung)
3) Research, Development and Environmental Information (Chair Mike Stekoll)
4) Public Education and Marketing (Chair Heather McCarty)
5) Workforce Development (Chair Paula Cullenberg)

**Expectations of ACs:**

- Work cooperatively for the benefit of the entire State of Alaska
- ACs will adhere to AO #280, including guiding principles and deadline (March 1, 2018)
- Chairs have the responsibility of calling and organizing meetings
- Membership in the ACs will be at the discretion of the Chairs
- Communication between the ACs and the TF will flow through the Chairs

**Purposes of ACs:**

- Each AC will assist the TF in addressing the essential element referred to in the AC name for purposes of integration and inclusion in the final comprehensive plan.
- Each AC will provide a connection to stakeholders and act as a two-way flow of communication between stakeholders and the TF.

**Scope of Work** – ACs and Chairs should use this as a general guide for their work:

- Timeline – provide short-term or most urgent recommendations to the TF by Nov. 9, 2016, and full recommendations to the TF by March 1, 2017.
- Conduct situational assessment relevant to each AC
    - Identify & utilize existing resources (information/orgs/Phases 2 & 3 eco analysis)
    - Identify opportunities or desired outcomes
    - Identify problems
        - Identify current or historic problems, impediments, obstacles, or needs
        - Identify past efforts to address problems
        - Identify why past efforts have failed
        - Identify information needs
- Identify solutions/strategies and new resources (info/orgs/$)
- Recommend implementation plan
    - Identify who, what, when, where, how, funding & prioritization
    - Think in phases: Phase 1 (1-10 yrs), Phase 2 (10-20 yrs), Phase 3 (20-30 yrs)
- Recommend evaluation plan which tracks continued progress

# Table of Meeting Dates
# for Mariculture Task Force, Advisory Committees, and Public Outreach

| Date | Location | Meeting Type |
|---|---|---|
| 3/4/16 | Anchorage | PUBLIC OUTREACH - Southwest Alaska Municipal Conference |
| 3/15/16 | Juneau | PUBLIC OUTREACH - Southeast Conference |
| 6/1/16 | Juneau | Mariculture Task Force |
| 6/20/16 | Juneau | Mariculture Task Force |
| 9/9/16 | Teleconference | Investment & Infrastructure Advisory Committee |
| 9/9/16 | Juneau | Regulatory Issues Advisory Committee |
| 9/21/16 | Ketchikan | PUBLIC OUTREACH - Southeast Conference |
| 9/25/16 | Teleconference | Public Education and Marketing Advisory Committee |
| 9/26/16 | Anchorage | PUBLIC OUTREACH - United Fishermen of Alaska |
| 9/30/16 | Juneau | Mariculture Task Force |
| 10/14/16 | Teleconference | Research & Development Needs and Environmental Information Advisory Committee |
| 10/27/16 | Teleconference | Workforce Development Advisory Committee |
| 10/28/16 | Teleconference | Research & Development Needs and Environmental Information Advisory Committee |
| 11/9/16 | Juneau | Mariculture Task Force |
| 11/17/16 | Seattle | PUBLIC OUTREACH - Pacific Marine Expo |
| 11/18/16 | Teleconference | Workforce Development Advisory Committee |
| 12/2/16 | Teleconference | Research & Development Needs and Environmental Information Advisory Committee |
| 12/8/16 | Anchorage | Regulatory Issues Advisory Committee |
| 12/9/16 | Anchorage | PUBLIC OUTREACH - Alaska ShellFish Growers Association Meeting |
| 1/11/17 | Juneau | Mariculture Task Force |
| 1/14/17 | Teleconference | Public Education and Marketing Advisory Committee |
| 1/20/17 | Teleconference | Investment & Infrastructure Advisory Committee |
| 1/26/17 | Sitka | PUBLIC OUTREACH - Alaska Fish Culture Conference |
| 1/27/17 | Teleconference | Research & Development Needs and Environmental Information Advisory Committee |
| 2/7/17 | Juneau | Advisory Committee Chairs |
| 2/9/17 | Teleconference | Workforce Development Advisory Committee |
| 2/10/17 | Teleconference | Research & Development Needs and Environmental Information Advisory Committee |
| 2/16/17 | Juneau | PUBLIC OUTREACH - JEDC Innovation Summit |
| 2/17/17 | Juneau | Mariculture Task Force |
| 3/3/17 | Anchorage | PUBLIC OUTREACH - Southwest Alaska Municipal Conference |
| 3/9/17 | Teleconference | Investment & Infrastructure Advisory Committee |
| 3/10/17 | Teleconference | Research & Development Needs and Environmental Information Advisory Committee |
| 3/13/17 | Juneau | Regulatory Issues Advisory Committee |
| 3/14/17 | Juneau | Mariculture Task Force |

# Table of Meeting Dates for Mariculture Task Force, Advisory Committees, and Public Outreach

| Date | Location | Meeting Type |
|---|---|---|
| 3/14/17 | Juneau | PUBLIC OUTREACH - Southeast Conference |
| 3/24/17 | Juneau | Regulatory Issues Advisory Committee |
| 4/14/17 | Teleconference | Research & Development Needs and Environmental Information Advisory Committee |
| 4/14/17 | Teleconference | Workforce Development Advisory Committee |
| 4/19/17 | Sitka | PUBLIC OUTREACH - Sitka Chamber of Commerce |
| 4/24/17 | Juneau | Regulatory Issues Advisory Committee |
| 4/26/17 | Juneau | Mariculture Task Force |
| 5/12/17 | Anchorage | PUBLIC OUTREACH - Innovate Arctic |
| 5/15/17 | Petersburg | PUBLIC OUTREACH - Petersburg Public Meeting |
| 5/19/17 | Teleconference | Research & Development Needs and Environmental Information Advisory Committee |
| 5/24/17 | Juneau | Mariculture Task Force |
| 5/26/17 | Teleconference | Research & Development Needs and Environmental Information Advisory Committee |
| 6/1/17 | Teleconference | Research & Development Needs and Environmental Information Advisory Committee |
| 6/8/17 | Teleconference | Research & Development Needs and Environmental Information Advisory Committee |
| 6/27/17 | Juneau | Mariculture Task Force |
| 8/23/17 | Juneau | Mariculture Task Force |
| 9/9/17 | Craig | PUBLIC OUTREACH - Craig Public Meeting |
| 9/20/17 | Haines | PUBLIC OUTREACH - Southeast Conference |
| 10/6/17 | Teleconference | PUBLIC OUTREACH - Fisheries Seafood Maritime Initiative |
| 10/11/17 | Juneau | Mariculture Task Force |
| 10/17/17 | Teleconference | PUBLIC OUTREACH - Alaska Ocean Cluster |
| 10/18/17 | Wrangell | PUBLIC OUTREACH - Wrangell Economic Development Committee |
| 11/3/17 | Teleconference | Public Education and Marketing Advisory Committee |
| 11/8/17 | Juneau | Mariculture Task Force |
| 12/7/17 | Ketchikan | PUBLIC OUTREACH - Alaska ShellFish Growers Association Meeting |
| 1/5/18 | Teleconference | Research & Development Needs and Environmental Information Advisory Committee |
| 1/10/18 | Juneau | Mariculture Task Force |
| 2/6/18 | Wrangell | PUBLIC OUTREACH - City of Wrangell |
| 2/13/18 | Juneau | PUBLIC OUTREACH - Southeast Conference |
| 2/15/18 | Juneau | Mariculture Task Force |
| 3/1/18 | Juneau | PUBLIC OUTREACH - United Fishermen of Alaska |
| 3/2/18 | Anchorage | PUBLIC OUTREACH - Southwest Alaska Municipal Conference |
| 3/19/18 | Seattle | PUBLIC OUTREACH - National Shellfisheries Association |

# Recommendations of the Investment and Infrastructure Advisory Committee

Prepared by the Investment and Infrastructure Advisory Committee for the Mariculture Task Force
November 2017

## Investment: Secure and promote investment in Mariculture

**Recommendation 1:**

*Support amendments to the Mariculture Revolving Loan fund to include hatchery eligibility. Encourage opportunities for increased support and funding of hatchery development.* (Near-term)

Under the leadership of AFDF, AC and MTF members have advocated for advancing legislation to amend the mariculture revolving loan fund during the 2017/8 legislative session. The I/I AC believes that legislation is needed to allow for fuller utilization of the existing mariculture revolving loan fund and to fill an important funding gap for hatcheries. The committee also believes that there should be a continued effort to align industry needs with private and public funding opportunities.

**Recommendation 2:**

*Support Shellfish Enhancement enabling legislation.* (Near-term)

As with the revolving loan fund legislation, AC and MTF members have been advocating for legislation that would provide a regulatory framework for shellfish enhancement and restoration efforts. This legislation is critical in advancing the AKCRRAB program out of research phase and into implementation. Future enhancement projects could provide important opportunities for common property fisheries and potentially help mitigate impacts of climate change on commercially valuable crab fisheries. The I/I AC believes this legislation will be key to advancing a successful mariculture industry.

**Recommendation 3:**

*Develop a single website location with a comprehensive list of funding sources for mariculture related development.* (Near-term)

The I/I AC has evaluated various public and private programs applicable to mariculture development in Alaska. The committee feels it would be helpful for to have a single tool or site outlining these sources.

**Recommendation 4:**

*Promote Cooperative Investment Structures* (Long-term)

Cooperative structures are designed to provide member level benefits that may be reflected on a social, cultural and/or economic level. Coops typically offer their members a wide variety of benefits such as access to markets, shared information on technological advancements and efficiencies, shared risk, innovation, common facilities, etc. This type of structure could build help build the financial resiliency of an emerging mariculture industry.

**Recommendation 5:**

*Explore the potential to seed a private/public revolving loan fund program for mariculture planning purposes and start-up costs.* (Mid-term)

Revolving loan funds provide access to a flexible source of capital that can be used in combination with more conventional sources. While the state's revolving loan fund is not presently being fully utilized, the anticipated growth of the industry may quickly surpass the amount of support that the fund provides. A complimentary revolving fund could provide an important bridge for new borrowers trying to leverage private sources. The fund could be initially capitalized through economic development organizations, federal grant programs or local governments.

**Recommendation 6:**

*Develop a business development training program, which dovetails with workforce development, to help new producers successfully apply for loans and develop business plans.* (Mid-term)

The I/I AC discussed the challenges that new entrants faced in developing the business plans required of most lending agencies. The group discussed the value of training opportunities catered specifically to producing and understanding financial projections.

**Recommendation 7:**

*Facilitate partnerships with state and local governments, industry, Alaska Native tribes, Community Development Quota organizations, NGOs and communities.* (Mid-term)

Developing strategic partnerships will help leverage local expertise, knowledge and funding sources.

**Recommendation 8:**

*Include in the comprehensive plan, a statement of commitment from the State of Alaska expressing support for sustainable mariculture growth and defining its role in helping industry to development and invest.* (Near-term)

The AC discussed how the success of the industry is dependent on the state's continued commitment to provide sufficient funding to agencies that are critical to regulating and supporting mariculture efforts. The AC also discussed that that it may be important for the state to reinforce its position on mariculture as a form of agriculture for the purposes of leveraging USDA funds.

**Recommendation 9:**

*Support Alaska delegation tours to share and extract lessons learned from mariculture operations and businesses from around the globe.* (Mid-term)

Information sharing in the early stages of mariculture development between existing growers and potential investors, both in-state and externally, will play an important role in the efficient growth of the industry.

**Recommendation 10:**

*Develop a fact sheet on survival and growth rates of various mariculture species.* (Long-term)

AC members from out of state discussed that the general lack of information on growth rates, survival and predation presented a significant impediment to their ability to develop business plans for investing in Alaska. The committee discussed how some information on growth rates may be available from ADFG and that a comprehensive product may necessitate a willingness from existing operators to share their experience and knowledge base. These types of inputs may be appropriate for a subsequent phase of the interactive mapping project.

## Infrastructure

**Recommendation 1:**

*Develop an interactive map tool and/or fact sheet to help inform site and species selection.* (Near-term)

The I/I AC understands that there is a Seagrant proposal to begin a regional mapping project and that the first phase of the project may begin in 2017. The AC committee supports this project and has discussed that the lack of a cohesive and accessible site containing information on issues such as; ocean conditions, bathymetry and existing support infrastructure for processing and shipping has created significant barriers for potential investors to adequately select sites and formulate business plans. A mapping tool will alleviate some of these limitations, while highlighting remaining research gaps and potential future inputs as they become available.

**Recommendation 2:**

*Develop a seafood processor outreach program to inform existing infrastructure owners of potential mariculture and business diversification opportunities.* (Mid-term)

Alaska's seafood operators have had to surpass significant challenges with remoteness, transportation, high energy costs and labor. An emerging mariculture industry will face similar challenges and will benefit from extracting lessons learned and building partnerships with existing operators. Numerous seafood processors throughout the state have expressed interest in exploring diversification opportunities through mariculture development. Many potential synergies exist, but information on compatible and potential conflicting conditions need to be better understood. This outreach program would likely follow the completion of the mapping project.

# Recommendations of the Public Education and Marketing Advisory Committee

Prepared by the Public Education and Marketing Advisory Committee for the Mariculture Task Force
January 2018

## Public Education

**Public education has two distinct components:**

1. **Advocacy** - Provide public outreach to multiple audiences to help assure realistic and positive views of mariculture, and support mariculture development in Alaska – an advocacy function.

2. **Information -** Provide ongoing sources of practical and factual information to the mariculture industry and the public.

Coordination of these functions is an important need. Existing entities perform parts of each function, and some perform in a coordinating role. The question for the Task Force is whether, going forward, these functions can continue to be done at an optimum level by existing entities. If so, by which entities, and what additional resources will they need.

Or, is there a need for a new entity? The recommendation from the Science and Research Advisory Committee for a new coordinating entity in that arena is an example of the identification of such a need.

**The following are elements of a comprehensive plan:**

**1. The primary audiences for public education** are: mariculture industry; seafood industry; State regulatory agencies; State Legislature; Federal entities and regulators; potential funding sources; environmental community; coastal communities; the Alaska Native community, including CDQ groups, Tribes and Native Corporations; the academic community.

When these priority groups are informed, the general public in and outside Alaska is also informed.

**2. Develop means for effective communication with each priority group that includes written material tailored to each audience, as well as presentations, meetings and ongoing coordination with groups and individuals.**

**3. Identify authority and responsibility for implementation of the plan recommendations by those entities best equipped to carry the process forward.**

This identification will be a crucial step in the Task Force process. The Task Force supports providing the identified entities with authority as needed, and supports obtaining the necessary resources for them to function.

Clearly, the Mariculture Task Force is currently providing information and advocacy for the development of the mariculture industry, but the MTF will sunset in mid-2018. Part of the responsibility of the groups listed will be to continue the outreach and information functions currently carried out by the Task Force.

**Existing entities and their capacity:** (Note: this list will change over time)

Alaska Fisheries Development Foundation. AFDF has acted in a coordinating and advocacy role in developing the Alaska Mariculture Initiative and supporting the MTF. AFDF is interested in moving forward in this role, and is seeking funding for Phase 2 of the Initiative (implementation).

Alaska Sea Grant. Sea Grant has a long history of supporting fishermen and fishing communities, aquaculture and mariculture. They provide a clearinghouse for information on all aspects of mariculture, as well as mariculture-related training and research.

Alaska Shellfish Growers Association (ASGA). ASGA is a membership-based trade association that provides advocacy for Alaska Shellfish Growers.

Pacific Coast Shellfish Growers Association (PCSGA). The PCSGA is a member-based organization representing shellfish growers in Alaska, Washington, Oregon, California and Hawaii. PCSGA works on behalf of its members on a broad spectrum of issues, including environmental protection, shellfish safety, regulations, technology and marketing.

Pacific Shellfish Institute (PSI). PSI is a Section 501(c)(3) private nonprofit organization providing mariculture research and information for the U.S. West Coast. PSI research and educational activities are aimed at supporting sustainable shellfish production and restoration, protecting marine ecosystems, reducing user-conflicts, and informing coastal planning decisions.

Oceans Alaska. Oceans Alaska provides support for mariculture advocacy, in addition to research and production.

Alutiiq Pride Shellfish Hatchery. Alutiiq Pride has been one of only two shellfish hatcheries in Alaska and has made significant contributions to production research and mariculture advocacy and development.

Alaska King Crab Research, Rehabilitation and Biology program. AKCRRAB provides coordination of research, experimental production and advocacy for king crab culture.

Southeast Alaska Tribal Ocean Research (SEATOR). SEATOR conducts shellfish testing to improve Tribal and rural access to traditional foods. SEATOR also facilitates the Southeast Alaska Tribal Toxins (SEATT) network to monitor toxic plankton blooms and ocean chemistry.

Alaska Ocean Observing System (AOOS). AOOS represents a network of ocean and coastal observations, data and information products that aid understanding of the status of Alaska's marine ecosystem.

The Nature Conservancy in Alaska is beginning to proactively engage in areas of environmental research (GIS map, data collection), and is interested in helping advocate in communities using its network of community-based staff.

**4. Provide central clearing-house for mariculture information.**

After adoption of the comprehensive plan, agree on the maintenance of web-based information related to mariculture in Alaska, including the plan implementation. For example, farmers have asked for streamlining of the regulatory/permitting process. Presuming that is a recommendation, the website should provide information as to its implementation, and a guide to navigating the permitting system.

Sea Grant currently provides a wealth of information on mariculture, and with further development and resources should continue to be the central information source. This role should include a web presence with links to regulatory agencies, funding sources and mechanisms, and research results.

**5. Recognize and counter opposition to mariculture and aquaculture.**

Challenges to public acceptance of mariculture include identified opposition to aquaculture and mariculture from environmental, academic and some community entities. Issues include the potential for environmental damage, genetic alterations, conflict with current marine uses including subsistence and commercial harvest, market concerns and aesthetic concerns.

The committee discussed the efficacy of public opinion surveys to determine public attitudes about mariculture, and agreed that information was needed. A well executed public opinion survey may help craft a communications strategy to address most important/frequent concerns. However, the Task Force recognized that the resources needed for such an effort were not currently available.

**6. Expand formal education in mariculture.**

The capacity of the University of Alaska to educate all manner of participants in the mariculture industry needs to be expanded. Sea Grant has focused on workforce development, and those programs should be supported and increased. Training for the researchers and production workers of the future shellfish and seaweed farms and hatcheries should become a central goal of the University system. University assets include appropriate locations, but academic programs and personnel need to be expanded.

**Current MTF work**

As the draft comprehensive plan is developed, the Task Force and AFDF are providing information in press releases and presentations to key industry groups and communities.

An important step will be to plan and conduct meetings and/or workshop to obtain public comment on the draft plan from stakeholder groups. This effort will bear fruit in the form of the needed support from industry and other stakeholders for the elements of the plan.

## Marketing

*(Note: The McDowell study also includes discussions of marketing of mariculture products.)*

ASMI plays a critical role in marketing of Alaska's existing seafood industry. ASMI is an asset of the state which includes a structure, staff, board, committees, funding mechanisms and positive reputation / brand presence. Consequently, ASMI should have a role in marketing Alaska's mariculture products. Clearly, the current focus of ASMI marketing is on wild harvest seafood.

The processors of that seafood contribute part of the revenue stream through a voluntary assessment allowed by Alaska statutes to fund ASMI's programs. Aquatic farmed products – such as seaweed and oysters – are currently not funding ASMI, so future producers will need to consider a contribution mechanism to ASMI funding in order to access ASMI's marketing machine.

ASMI will need to consider how to incorporate mariculture products into their strategic plan. In addition, will need to consider changes to its advertising tag line ("Wild, Natural, Sustainable").

ASMI should also continue to build its collaboration with the Alaska Grown program, which will also benefit aquatic farmers as well as land-based farmers and build synergy in a larger group of Alaska Food Producers. Alaska Grown is open to mariculture participation and includes access to the Agriculture Revolving Loan Fund. This is a resource that is already available to aquatic farmers and several already access the program. Continuation of access and alignment with the Alaska Grown program will be important, particularly during the early stages of mariculture development.

Advocating some awareness of mariculture products even at the early stages of development by ASMI actually might help in marketing of Alaskan seafood products as a whole because offering a wide range of products attracts customers, even if the vast volume and value of sales is centered on fish products. If, in the future, a larger portion of Alaskan seafood sales is farm raised, then financial support of ASMI from that group will undoubtedly increase. Demand for increased advertising support would be linked to increased funding levels. Increased awareness of pristine growing water in Alaska, which is vital for farm raised product, could only add to the desirability of other Alaskan seafood from those same waters.
General education about mariculture will be folded into any marketing of mariculture products, as sustainable resource management is also highlighted in wild seafood marketing.

Western United States Agriculture Trade Association (WUSATA) is also an existing resource for aquatic farmers. WUSATA provides information, services and matching funds for business which are marketing exported mariculture products.

# Recommendations of the Regulatory Issues Advisory Committee

Prepared by the Regulatory Issues Advisory Committee for the Mariculture Task Force
February 16, 2018

The Alaska Mariculture Task Force (MTF) Regulatory Issues Advisory Committee (AC) met five times between September 2016 and April 2017, as well as communicating via email, to identify perceived regulatory challenges to the growth of the mariculture industry in Alaska and to develop recommendations for actions to address these challenges. Members and contributors to the AC included: Sam Rabung (Chair, ADFG); Jim Aguiar (Aquatic Farmer); Adam Smith (DNR); John Kiser (Aquatic Farmer); Kim Stryker (DEC); Eric Wyatt (Aquatic Farmer); Christy Colles (DNR); Chris Whitehead (Sitka Tribe); Julie Decker (AFDF); Clark Cox (DNR); Paul Fuhs (Aquatic Farmer); Eric O'Brien (Aquatic Farmer).

**What is Mariculture?**

Mariculture, simply put, is marine aquaculture or the culture of marine organisms. Mariculture includes both rehabilitation and enhancement of wild fisheries and aquatic farming. Rehabilitation and enhancement is the culturing of marine organisms for release into the wild to benefit common property wild capture fisheries. Aquatic Farming is the culturing of marine organisms in captivity or under positive control to benefit private business.

Shellfish rehabilitation and enhancement permits are currently not authorized in Alaska, therefore the only legal form of mariculture in Alaska as of this writing is aquatic farming. Most of the aquatic farm product currently grown in Alaska is Pacific oysters and blue mussels. However, as the industry continues to expand and culture techniques are refined, it is anticipated other products such as the geoduck clam, littleneck clams, and marine plants will gain prominence within the industry.

**Brief Legal Background for Mariculture in Alaska**

Constitution

Alaska is a common property resource state and the Alaska Constitution includes provisions relating to common use. Most tide and submerged lands within Alaska's 40,000 miles of coastline are a common property resource managed upon multiple use principals and sustained yield requirements. The State of Alaska Constitution requires resource decisions to be vetted through a public process and noticed for public input to balance resource management decisions with the best interests of the State of Alaska. Management of replenishable resources for sustained yield is enshrined in Article 8, Section 4, of the constitution. Article 8, Section 15, specifically prohibits exclusive right of fishery; however, this section was amended in 1972 to provide exemptions for the state to both limit entry into fisheries for conservation and economic reasons, and to provide for the efficient development of aquaculture in Alaska. Article 8 also provides for the use of state lands and waters, with certain assurances, in Sections 8 and 14. Article 7 requires that the legislature provide for the promotion and protection of the public's health.

Statute

Several statutes have been approved by the Alaska Legislature that provide for mariculture activities in the State. The fisheries rehabilitation, enhancement and development statute (AS 16.05.092) went into effect in 1971, directing the Alaska Department of Fish and Game (ADFG), in part, to encourage private investment in the development and economic utilization of fisheries resources, and through rehabilitation, enhancement and development programs, do all things necessary to ensure perpetual and increasing production and use of the aquatic resources of the state.

The Aquatic Farm Act (Section 19, Chapter 145, SLA 1988) was signed into law on June 8, 1988, authorizing the Commissioner of ADFG to issue permits for the construction or operation of aquatic farms, and hatcheries to supply aquatic plants or shellfish to aquatic farms (AS 16.40.100 - 199). The intent was to create an industry that would contribute to the state's economy and strengthen the competitiveness of Alaska seafood in the world marketplace, broadening the diversity of products and providing year-round supplies of premium quality seafood. The law limited aquatic farming to shellfish and aquatic plants and in 1990 CSHB 432 became law, prohibiting farming of finfish in the state (AS 16.40.210).

Statute also authorizes Alaska Department of Natural Resources (DNR) to make land and water available through lease for aquatic farming subject to bonding or other security (AS 38.05.083). All lease applications and proposed decisions are required to be noticed for public comment per AS 38.05.945 before a final decision is rendered by DNR.

Statutes that direct the Alaska Department of Environmental Conservation (DEC) to provide for food safety are found in the Alaska Food, Drug, and Cosmetic Act in AS 17.20.

There is currently no statutory authorization to issue permits for shellfish rehabilitation and enhancement projects, however, bills were introduced in 2016 and again in 2017 to achieve this.

**Statewide Aquatic Farm Program and Agency Roles**

The statewide program is jointly administered by three state agencies: the Department of Natural Resources (DNR), the Alaska Department of Fish and Game (ADFG), and the Department of Environmental Conservation (DEC). Each of these state agencies has a specific role in authorizing and managing aquatic farm activities within Alaska.

The DNR authorizes the use of tide and submerged land and seeks to balance use of the land for the development of aquatic farming with traditional uses of the area, upland owner access, public access, and navigation of public waters as required under Article VIII of the Alaska State Constitution. The department is required to balance disposal of interest (lease) decisions with traditional and existing uses within a given area to ensure proposed farm sites are compatible. If approved, leases authorize a specific footprint and infrastructure to remain on state land to support aquatic farming activities. DNR is required to charge no less than appraised fair market value for lease fees which require annual land use fees. Lease holders are also required to post a bond to cover the costs to the department of restoring leased sites in the event the site is abandoned. Other requirements include providing proof of commercial liability insurance and meeting the commercial use requirements outlined within 11 AAC 63.030(b) within five years of lease issuance. DNR aquatic farm regulatory guidance is contained in 11 AAC 63.010 – 050.

The ADFG issues permits for the operation of aquatic farms and aquatic farm hatcheries, acquisition of stock, and transport of seed and aquatic farm products; certifies and permits seed coming into the state and transported within state for aquatic farming, ensures aquatic farming does not significantly alter established fishery or other existing uses of resources, does not significantly affect fisheries, wildlife or their habitats in an adverse manner, and determines wild stock populations prior to permitting aquatic farm species. ADFG employs the "precautionary principle" when authorizing use of resources in order to ensure sustained natural productivity of common property resources. Specific ADFG aquatic farm regulatory guidance is contained in 5 AAC 41.001 – 400.

To protect human health, the DEC classifies growing areas, issues permits, conducts inspections, investigates complaints, conducts outreach and training, and monitors bacteria and toxins in shellfish harvest areas (growing waters) and shellfish products. Primarily, two programs within DEC are involved: the Food Safety and Sanitation program (FSS), the state's Shellfish Sanitation Authority, and the Environmental Health Laboratory (EHL), which provides the FSS program analytical support to carry out its responsibilities. DEC regulates the shellfish industry through adoption by reference at 18 AAC 34 of a document called the National Shellfish Sanitation Program Model Ordinance (NSSP MO). The NSSP MO specifies sanitation requirements for harvesters, dealers, and shucker/packers and outlines State regulatory program requirements so that bivalve shellfish grown and harvested in Alaska may be sold interstate.

**Regulatory Issues Advisory Committee Recommendations**

The table below presents the Regulatory Issues Advisory Committee's recommendations to address regulatory challenges to mariculture in Alaska. These recommendations were identified through broad participation with farmers, industry representatives and state agencies, and are organized by priority groupings of 1) Near Term needs; 2) Intermediate Term needs; and 3) Long Term needs.

*Many of these suggestions require legislation, funding, or both. These nonbinding recommendations are offered to the Mariculture Task Force for consideration and do not commit any industry representative or agency to additional action beyond these recommendations.*

**1.)** Priority: 1, Agency: ADFG

Regulatory Issue
Shellfish stock restoration, rehabilitation, and enhancement projects are not legal in Alaska, other than for small scale research or for ADF&G projects.

Recommendation to Address
Pass legislation creating authority to issue permits for this type of activity (2016 HB300/SB172; 2017 HB128/SB89)

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**2.)** Priority: 2, Agency: ADFG

Regulatory Issue
Importation of seed from outside of Alaska is limited to only Pacific Oysters from the pacific Northwest, and to Weathervane Scallops produced from parents taken from SE Alaska and Yakutat areas.

Recommendation to Address
Amend regulation (5 AAC 41.070 Prohibitions on importation and release of live fish) to allow for other species using the Weathervane Scallop model.

**3.)** Priority: 2, Agency: ADFG

Regulatory Issue

Genetic requirements are restrictive and limit wide distribution of indigenous organisms for farm stock. These requirements include limitations on the distance from the donor stock acquisition location that progeny may be grown out at, and large minimum donor stock numbers to ensure genetic diversity in progeny.

Recommendation to Address

**(A)** Indigenous stock used on farms that can reproduce naturally in those same waters may potentially impact natural production of that species locally. However, if triploid (sterile) stock is used, or if the species does not occur or reproduce naturally in an area, there are no genetic concerns. Adopt regulation to clearly state that sterile stock, and species that do not occur or reproduce naturally within some significant distance of the farm growing area, are not subject to the ADF&G genetic policy. **(B)** Adopt regulation to require a timeline for action to gain information when a lack of genetic stock structure data for a species forces precautionary restrictions on transport of indigenous organisms used as mariculture seed.

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**4.)** Priority: 3, Agency: ADFG

Regulatory Issue

Aquatic (wild) stock acquisition is limited to only initial needs in Statute (AS 16.40.120(f)(1)) and regulation (5 AAC 41.290(b) and (d)).

Recommendation to Address

Donor stock of indigenous species may need to be collected on a continual basis to propagate and produce seedstock for aquatic farms and nurseries and for growout of natural set on farm sites. Amend the statute and regulations to remove the word "initial".

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**5.)** Priority: 1, Agency: ADFG

Regulatory Issue

Requiring excessive detail and speculative information on applications and plans, and inflexibility to species and gear diversification in real time.

Recommendation to Address

Adhere to the actual language in statute and regulation in order to avoid "over reach". Any information requested should have an identified purpose and need. Additional requirements or restrictions should be promulgated through statutory and regulatory change processes rather than personal interpretations.

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**6.)** Priority: 1,2,3 Agency: DNR

Regulatory Issue

Bonding, insurance, and annual land use fees are challenging for farmers to pay, especially new farmers not selling product yet.

Recommendation to Address

**(A - Priority 1)** Establish a mechanism or funding source to offset lease costs. This could be tied into aquatic farm loan programs and provide start up financing for new farmers. Amend regulation to allow for deferring a portion of fees, or for a graduated increase in lease fees, until farm site is producing. **(B - Priority 2)** Farmers with demonstrated training or experience working a farm, or new farmers that locate near an established farm, should be considered for a reduced bond amount since they will be lower risk. **(C - Priority 3)** Adopt industry sponsored training or best practice standards to ensure new farmers understand aquatic farm site selection, husbandry practices, marketing and financial planning requirements. This may increase success of the new farmer but may not remove bonding requirements.

**7.)** Priority: 2, Agency: DNR

Regulatory Issue
DNR statute AS 38.05.083(e) & regulation 11 AAC 63.080 require bonds to pay any defaulted lease fees and cleanup a site if abandoned by the leaseholder. The minimum bond amount of $2500 is not adequate surety to clean up sites.

Recommendation to Address
**(A)** Pass legislation to create a bond pool which could be utilized to cleanup abandoned farms and pay default fees. A bond pool could reduce individual bond requirements if it were adequately funded. **(B)** Obtain legal authority to enter into agreement with another farmer(s) to clean up a defaulted farm site, incentivized by offering the defaulted farms security bond, gear and inventory as compensation upon successful restoration of the defaulted farm site.

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**8.)** Priority: 2, Agency: DNR

Regulatory Issue
Commercial Liability Insurance and Worker's Compensation Insurance requirements are expensive for farmers.

Recommendation to Address
Pass legislation to create insurance coverage for commercial farmers or encourage broad insurance policies to be adopted by industry sponsored groups or organizations that cover its members.

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**9.)** Priority: 1, Agency: DNR

Regulatory Issue
The commercial use requirement (11 AAC 63.030(b) is a low benchmark for farmers to demonstrate their farms commercial viability by year 5 of a lease. This benchmark does not work for all species.

Recommendation to Address
Amend 11 AAC 63.030(b) to consider a longer term for farms producing only slow growing species such as geoduck and a shorter term for farms producing only fast growing species such as seaweed.

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**10.)** Priority: 2, Agency: DNR

Regulatory Issue
Lease size is required to encompass the entire foot print of the farm site including anchors and scope of lines. This expands lease size substantially for larger farmers which increases cost per surface acre farmed and ties up additional surface area not actually being farmed.

Recommendation to Address
Amend regulations to separate actively farmed lease acreage, such as surface water footprints, from the on bottom acreage needed to secure infrastructure such as the anchors, lines and scope for purposes of calculating the lease fee.

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**11.)** Priority: 1, Agency: DNR

Regulatory Issue
Escalating lease fees during the lease period makes it difficult to plan the operations/expenses of the farm.

Recommendation to Address
Only change the lease fee when the lease is renewed or transferred. Do not change the lease fee during the effective period of the lease.

**12.)** Priority: 1, Agency: DEC

Regulatory Issue
There is a lack of open access to collected and reported environmental data. Farmers, and others, need open access to this data in order to conduct individual analysis and to assist DEC and others conducting problem-solving efforts.

Recommendation to Address
Make the data visible, or if it is not utilized and stored, do not require that it be collected and submitted. DEC has been working towards providing for an open data exchange/viewing site since April of 2016. If this is not feasible within DECs resources, allow industry to establish an authorized industry-wide database or assist DEC with creating one that can provide this service.

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**13.)** Priority: 2, Agency: DEC

Regulatory Issue
Growing water sampling and PSP testing is slow and expensive. It is extremely challenging for many farmers to transport water samples to the DEC laboratory in Anchorage within the time and temperature constraints required.

Recommendation to Address
**(A)** Support certification of additional private labs and testing methods in order to facilitate ease of transport, faster results and more cost effective testing. **(B)** Support research into holding for depuration and certification of process.

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**14.)** Priority: 1, Agency: DEC

Regulatory Issue
In order for molluscan shellfish (excluding kelp and crustaceans) product to be able to be placed into commerce outside of Alaska, the Alaska Shellfish Authority (DEC) must demonstrate that it is meeting all of the requirements of the National Shellfish Sanitation Program and maintain its membership in the Interstate Shellfish Sanitation Conference. It is only through this membership that Alaska shellfish dealers are able to export product to many other countries and ship to other states across this nation.

Recommendation to Address
Ensure that DEC has the resources and support necessary for industry to maintain access to commercial markets and protect public health.

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**15.)** Priority: 2, Agency: ALL

Regulatory Issue
Communication is not organized to reach all farmers and industry representatives. There is no authorized body representative of farmers and industry to work with agencies in drafting and implementing rules and regulations.

Recommendation to Address
Pass legislation to establish a comprehensive board or group to represent farmers and industry in interactions with regulatory agencies.

**16.)** Priority: 1, Agency: All

Regulatory Issue

There is a seemingly adversarial role by some regulators towards mariculture. Recognizing that departments operate within many strict guidelines, regulations, statutes, and manpower and fiscal constraints, and that many of those are necessary to protect the public, there is an impression that some individual regulators tend to interpret guidance more stringently than is required or was intended, or that enforcement of a flawed rule or regulation is easier than seeking a beneficial solution.

Recommendation to Address

Direct regulatory agencies to adopt an advocacy approach to the mariculture industry for the benefit of the State. Regulators should seek to make improvements to bureaucratic rules and regulations that needlessly impede the growth of the industry while still fulfilling their responsibilities to protect the people and resources of the state.

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**17.)** Priority: 3, Agency: All

Regulatory Issue

There is no assurance to the State that an aquatic farmer is qualified or capable. Regulatory agencies have a responsibility to the people of the State to ensure that resources are used wisely. One reason for the oversight and stringent requirements imposed upon aquatic farmers by the State is that there is no way to determine if a farmer has the knowledge and/or experience to operate a farm.

Recommendation to Address

Amend agency regulations to provide for acceptance of industry-driven training as qualification. Aquatic farmers are currently developing a series of training and accreditation efforts that will provide a better trained workforce and better, more knowledgeable, farmers/operators who will have standardized skills and knowledge, as a minimum. When this program is fully developed and implemented, this accreditation/certification should be accepted and used by state agencies to demonstrate an applicant has the knowledge and skill sets required to work on, or operate, a successful farm. This should be considered an endorsement for favorable consideration of the farmers aquatic farm permit application, lower bonds, initially smaller lease rates, loan guarantees, etc.

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**18.)** Priority: 2, Agency: Federal

Regulatory Issue

The U.S. Army Corp of Engineers (USACE) Aquaculture General Permit expired in 2014. Now all aquatic farmers must apply for individual permits.

Recommendation to Address

Seek a new USACE Aquaculture General Permit for Alaska.

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**19.)** Priority: 1, Agency: Federal

Regulatory Issue

National Marine Fisheries Service (NMFS) marine mammal guidance restricts aquatic farm sites from being within 1 mile of harbor seal haulout concentration areas or pupping areas and within 3 miles of Steller sea lion haulout concentration or pupping areas. This effectively removes a very large proportion of potential aquatic farm sites from consideration.

Recommendation to Address

Work with NMFS to seek clarification and refine this guidance, determine if it is valid in all circumstances, and if there are other considerations that might mitigate concerns for potential marine mammal disturbances.

# Recommendations of the Research and Development Advisory Committee

Prepared by the Research and Development Advisory Committee of the Alaska Mariculture Task Force
June 2017

**Near-Term Priorities for Mariculture in Alaska**

Near-term priorities are defined as priorities for species of immediate interest (1-2 years) for mariculture in Alaska along with specific issues that need to be addressed to create a viable commercial enterprise for each species. For an overview of the near, intermediate, and long-term priorities for mariculture in Alaska, see **Appendix H - Existing Research and Future Needs**.

**I. Near-term research priorities for shellfish farming in Alaska**

*Oysters, Pacific*

1. Research focused on oyster spawning in Alaska
    a. Develop capacity to spawn oysters in Alaska - **High Priority**
        i. Physical systems to spawn exist at Alutiiq Pride Shellfish Hatchery (APSH) and OceansAlaska (OA); access to certified broodstock; currently conditioning broodstock at OceansAlaska; proposed partnership with Alaska Sea Grant (ASG) for funding to initiate spawning on more than a test basis. Note: Seed from certified broodstock that is permitted to be imported into Washington and California has much larger demand than seed only permitted for planting in state. Some farms in Pacific Northwest value a completely independent source of oyster seed.
    b. Research and develop methods and ability to buffer incoming seawater with calcium aragonite (a form of CaCO3). **Medium Priority**
        i. Buffering seawater into culture tanks with sodium carbonate is current practice at OA. However, drip concentration is adjusted by measuring pH. Direct measurement of calcium aragonite concentration will lead to more accurate buffering data and practice.
    c. Develop region specific broodstock breeding program. **Medium Priority**
        i. Spawning of Alaska broodstock can lead in small steps toward a simple breeding program. The immediate goal is to have an in-state source of larvae and to start discussion of breeding program genetics.
2. Research focused on oyster larvae setting and growth to nursery size in Alaska.
    a. Develop capacity to set sufficient quantities of oyster seed **High**
        i. This is currently underway at Oceans Alaska, and there is recently some interest in additional private setting facilities
        ii. Alaska Sea Grant has submitted a grant proposal to NOAA to support further development of oyster larvae setting capacity and best practices and researching b,c,d and e below.
    b. Research efficacy of seed fluidizers. **High**
    c. Research live feed vs. commercially available algae concentrate. **High**
    d. Research and develop methods to combat colonial ciliates in the hatchery. **Medium**
        i. Basic experimentation with chlorine and ascorbic acid to combat ciliates at OceansAlaska
    e. Research comparison of differing sea water filtering systems. **High**

f. Compare growth rates and survival of over-wintered oyster seed to farm market size vs. newly set oysters. This greatly affects the ability of a hatchery to supply the quantities of instate seed needed prior to the Alaskan growing season, which is much more restrictive for juvenile oysters than in lower 48**High**
g. Determine economic viability of shellfish hatcheries. **High**
    i. British Columbia Shellfish Aquaculture Industry did a hatchery feasibility report on this topic:https://www2.viu.ca/csr/documents/HatcheryFeasibilityReport080606CSR_002.pdf

3. Research focused on oyster nursery stage
    a. Research and develop low cost nursery options for farmers. **Medium**
        i. Some work on this has already been developed at OceansAlaska with fish tote based upwellers.
    b. Research and develop methods and equipment to increase efficiencies of nursery systems. **Medium**
        i. Successful private efforts (namely Jim Aguiar) in the past centered around floating upweller systems (FLUPSYs) and collaboration with Alaska Sea Grant to some degree on this.
    c. Develop and disseminate ability for nurseries and farmers to successfully raise smaller seed than is currently standard.
        i. Private efforts have been underway, but nothing seems definitive.
4. Research focused on oyster farms and shellfish processing.
    a. Develop improvements in production technology. **Medium**
        i. Identify strategies and best practices to reduce the cost of labor and time to produce aquatic farm product.
        ii. Alaska Sea Grant efforts in the past; mostly private efforts with info sometimes shared at Alaska Shellfish Growers Association annual meeting.
    b. Research and develop frozen and value added products aimed at out of state markets. **High**
        i. Work on TVO (top valve off) frozen oysters done by Alaska Sea Grant/Fishery Industrial Technology Center (renamed as the Kodiak Seafood and Marine Science Center).
        ii. Development and market acceptance of frozen oysters could be a huge "game changer" with regard to Alaskan grown oysters. Specifically, a frozen whole oyster product form could reduce transportation bottlenecks and transport costs (which are significant), allow for harvest around PSP or other detrimental environmental events, allow for harvest crews and capacity to move between farms, increase shelf life dramatically and open up new or expand existing markets.

*Mussels, Blue*

1. Identify genetic and disease issues that prohibit/inhibit the growing of blue mussels to market size in Southeast Alaska. **High**
2. Continue research on production technology.
    a. Publish and disseminate current production techniques already researched in Alaska. **High**
    b. Develop hatchery production of mussel seed. **Medium**
    c. Develop predator control methods. **High**
3. Develop frozen product form and other value added products and methods.
    a. Frozen product form is widely accepted as mussels are traditionally cooked for eating and frozen product has acceptable quality parameters; freezing technology is widely known/practiced in Alaska; theoretically Alaska frozen mussels could compete with Irish mussels in the world market. **High**
    b. Research other ways to create value added products with mussels. **Medium**
4. Develop improvements in production and processing methods to increase throughput.
    a. Mussel farming (internationally) lends itself to a degree of mechanization more so than oyster production; which may lead to better competitive advantage in Alaska's labor poor environment. **Medium**

**II. Near-term research priorities for shellfish enhancement in Alaska**

*King crab (Paralithodes camtschaticus; Paralithodes platypus)* (priorities developed by the Alaska King Crab Research Rehabilitation and Biology Program)

1. Refine rearing protocols for red and blue king crab by:
    a. Optimizing rearing conditions and hatchery techniques to both improve survival rates and reduce production costs.
        i. Has been done for red king crab but needs to be refined for blue king crab at the Alutiiq Pride Shellfish Hatchery.
    b. Optimize rearing conditions and hatchery techniques to reduce behavioral, morphological, and physiological differences between hatchery and wild crabs in order to minimize potential competitive interactions with future outplanting.
        i. Work has started at UAF and NOAA but additional work needed.
2. Understand the behavioral, morphological, and physiological differences between hatchery-reared and wild juvenile king crab and potential competitive interactions.
    a. Determine if morphological and behavioral differences are present between hatchery-reared and wild king crab juveniles and identify any potential competitive interactions or advantages.
    b. Continue to compare bioenergetics of hatchery-reared and wild king crab juveniles to understand health and energy allocation and identify any potential competitive interactions or advantages.
        i. Early work done by NOAA and University of Oregon but additional work needed in collaboration with outstocking experiments.
3. Determine optimal nursery habitats to maximize growth and survival of juvenile king crab in both the hatchery and once outplanted.
    a. Identify the habitat requirements of juvenile king crab through their first year of life, including foraging, structural, and biological habitat attributes, as well as ontogenetic shifts, with continued laboratory and field studies.
        i. Initial habitat suitability index models done but more refined studies needed to assess requirements at outstocking densities.
        ii. Further develop king crab habitat suitability models for red king crab and begin development of models for blue king crab based upon laboratory and field studies for research use, as a guide to selecting potential release sites.
    b. Develop best practices for transporting large numbers of juvenile king crab to remote sites without incurring high mortalities or harming their health.
4. Assess likelihood of outplanting success based on biological and environmental interactions.
    a. Transport to and successfully maintain live juveniles in a shore-based facility in the Pribilof Islands.
        i. Facilities are being developed with tribal government collaborations.
    b. Conduct tethering experiments in the Pribilof Islands to assess optimal habitats, crab size, relative predation and seasonal conditions for outplanting success.
    c. Quantify predation pressure at potential release sites in the Pribilof Islands and during experimental releases in Kodiak.
        i. This work is currently ongoing by NOAA in Kodiak. A joint UAF-NOAA research project is underway in St. Paul.
    d. Survey habitat, environment, and juvenile red and blue king crab density at potential release sites in the Pribilof Islands.
        i. A joint UAF-NOAA research project is underway in St. Paul.
    e. Monitor predation, prey availability, and competitive interactions before and after controlled release events and evaluate predator control devices.

5. Investigate fate of hatchery-produced juvenile king crab during release experiments.
    a. Design and test in the lab, nursery structures that may provide an artificial habitat to reduce initial mortality upon release for hatchery-produced juvenile king crab in the marine environment.
        i. Initial studies underway by NOAA in summer 2017.
    b. Continue to assess the behavior and marine survival of hatchery-produced juvenile king crab released into the wild at sites with appropriate habitat near Kodiak Island.
    c. Investigate larger controlled releases (~100,000 juveniles per site) to evaluate if crabs can be rehabilitated on an embayment scale in Kodiak.
    d. Assess the behavior and marine survival of hatchery-produced juvenile king crab released into the wild at sites with appropriate habitat near the Pribilof Islands.
6. Project operational costs for producing juvenile red and blue king crab for enhancing depressed wild crab stocks, including hatchery, nursery, and stocking phases.
    a. Continue to document hatchery operational costs from acquiring broodstock through production of C3 juveniles.
    b. Develop and publish cost projections for the culture of C3 juveniles for different survival rates and levels of production.
    c. Develop and publish projected costs of operating various stocking and nursery projects.
7. Determine funding mechanisms and identify any potential changes in state law and regulations necessary to allow crab harvesters and/or coastal communities to conduct king crab rehabilitation activities.
    a. Work with legislators and state agencies to research the potential legal framework for crab harvesters or coastal communities to form an association, such as a private-nonprofit corporation, to conduct rehabilitation activities.
    b. Work with legislators and state agencies to research the following: Who will pay? What changes to state law are necessary to provide for a voluntary assessment similar to the salmon rehabilitation program? Is it possible to have cost recovery harvests of enhanced king crab to offset costs? If so, what changes in statutes are necessary?
    c. Begin implementation of any necessary changes in law and policy.
        i. Legislation defining enhancement management processes was introduced but not passed in 2016 and 2017.
8. Work with potential user groups to develop preliminary collaborations with community and/or industry groups interested in forming rehabilitation associations.

**III. Near-term research priorities for seaweed mariculture in Alaska**

*Saccharina latissima* (sugar kelp) and *Alaria marginata* (ribbon kelp)

1. Research the population genetics of seaweeds of current and future commercial importance in order to better understand how seaweed farms might affect the natural populations.
    a. Priorities should be the population genetics of Saccharina latissima and Alaria marginata especially in the areas along the Gulf of Alaska.
        i. Some of this research is currently being done by ADF&G genetics group.
2. Research to determine the best practices for obtaining parent plants for seed production.
    a. Research on collecting parent seed stock from natural populations.
    b. Research on using parent seed stock from maricultured outplants.
    c. ADF&G ongoing genetic research will partly address some of these issues
3. Research on strain selection.
    a. Currently this can only be done as non-commercial research with limitations on outplanting select strains.
        i. Some of this research is being done at University of Alaska Southeast (UAS) with ASG and Blue Evolution (BE) funding.
4. Market and product research for sugar and ribbon kelp
    a. Unknown if anyone is doing this.

5. Research on hatchery optimization for large scale production of seeded string
    a. BE and UAS are involved in this.
6. Research needed on optimal timing of outplanting and harvest (at different sites in Alaska).
    a. Some of this is being done by UAS and BE.
7. Research on the optimal conditions for growth (depth of outplant, nutrients, temperature, light, salinity, current).
    a. Some of this is being done by UAS, but other sites need to be outplanted and monitored.
8. Site selection research.
9. Oceanographic monitoring at existing growing sites, including nitrogen, phosphate, salinity, temperature, turbidity and currents.
    a. Some of this being done by UAS and may be part of an ARPA-E grant in the near future.

**IV. Near-term research priorities for new species mariculture in Alaska**

General

1. Begin the process to identify new species that present potential economic opportunity in Alaska based on previous studies or successful mariculture in other regions.

**V. Near-term research priorities for environmental data collection to support mariculture in Alaska**

Bivalves and public health issues

1. Rigorously research and develop methods to monitor and mitigate Vibrio P. occurrences.
    a. DEC has developed Vibrio P. plan for farmers when this occurs (http://dec.alaska.gov/eh/fss/seafood/Shellfish_Home.html).
2. Research and develop methods to mitigate harvest disruptions due to wild animal fecal coliform in remote areas.
    a. Grant funding proposal Alaska Sea Grant/Pacific Shellfish Institute in WA.
3. Develop public platform to access Paralytic Shellfish Poisoning (PSP) data.
    a. Proposed action on this by Alaska Sea Grant. AOOS and SEATOR may be helpful with this.
4. Research and develop low cost PSP testing methods.
    a. SEATOR (http://www.seator.org/) in Sitka is pursuing certification to conduct certified PSP testing which would reduce the testing burden on the State Environmental Health Lab and could lead to further R&D opportunities.
5. Identify appropriate regions to increase spatial extent of PSP testing (e.g. Kodiak Island) to address potential for underdeveloped opportunities for shellfish farms.
6. Develop a data base of the occurrence of PSP and causation in Alaskan waters.,

Site selection

1. Develop prioritized physical and biological data collection necessary for site selection by species (bivalve, crab, seaweed) or method (farm, enhancement) of interest. This would include information to avoid areas with PSP, large wildlife populations, anadromous streams, higher freshwater influx etc.
2. Do basic oceanography studies of existing growing areas in cooperation with the farmers to understand biophysical factors contributing to shellfish growth rates and meat yields.
3. Identify and support research to assess mechanism of PSP loading (cyst density) in different species (e.g. oysters, geoducks).

Site specific measurements

1. Develop prioritized physical and biological data collection necessary for site operation by species (bivalve, crab, seaweed) or method (farm, enhancement) of interest.
2. Develop an active list of what is currently being monitored at each site and work with regional groups (e.g. AOOS) to host the database and website for public data access.

Regional measurements

1. Develop prioritized physical and biological data collection necessary to provide regional and seasonal information to assist with farm or enhancement operations.
2. Identify regional groups (e.g. AOOS) to host a mariculture database and website for access by the farmers and the public.

3. In addition to other physical measurements, develop or maintain carbonate chemistry monitoring in all coastal regions with feasible mariculture opportunities that may be affected by ocean acidification. Locations include:
    a. OceansAlaska Ketchikan (http://www.ipacoa.org/; http://nvs.nanoos.org/ShellfishGrowers) is currently monitoring carbonate chemistry including alkalinity, CO2, TCO2, Aragonite saturation, pH, salinity, and temperature.
    b. AMHS M/V Columbia has been outfitted with an underway CO2 system on the passenger ferry Columbia that services SE Alaska communities (Haines, Skagway, Juneau, Sitka, Petersburg, Wrangell, and Ketchikan).
    c. SEATOR Sitka (www.seator.org) is currently monitoring carbonate chemistry including alkalinity, CO2, TCO2, Aragonite saturation, pH, salinity, and temperature.
    d. APSH Seward is currently monitoring carbonate chemistry including alkalinity, CO2, TCO2, Aragonite saturation, pH, salinity, and temperature. APSH also processes discrete samples and has reached climate data ratings.
    e. Kasitsna Bay Laboratory has a discrete carbonate chemistry monitoring program.
    f. Prince William Sound Science Center is routinely monitoring oxygen but should expand to match capacity at other regions.
    g. NOAA Kodiak Laboratory will be monitoring carbonate chemistry in FY18 and should include additional monitoring including alkalinity, CO2, TCO2, Aragonite saturation, pH, salinity, and temperature.

**VI. Near-term research priorities for economic data collection to support mariculture in Alaska**

General

1. Development of a web-based break-even analysis planning tool that can be used to explore the effects of farm scale, production intensity, scope, and location on financial viability of shellfish mariculture operations. Includes an analysis of production efficiency related to farm operation and technology.
2. Development of regional and social impact models to highlight the role of aquatic farms in local and regional economies including employment and income impacts.
3. Development of risk management tools to integrate consideration of production risk (survival, growth, etc.) and financial risk (input costs, price volatility, etc.).
4. There is need for research designed to identify strategies for management of production and price risk.
5. Studies to explore role of horizontal and vertical integration or coordination as mechanisms for developing stronger markets, reducing input factor costs, and mitigating risk.
6. Outlook and trends for product prices and demand for Alaskan mariculture products.
7. Economic profile of the existing mariculture industry, including the number of farms, the years of operation, the species grown, farm size, region, etc.
8. Establish goals for industry growth.
9. Investigate existing fisheries infrastructure for possible use in mariculture.

**VII. Near-term research priorities for education to promote regional scale mariculture opportunities in Alaska**

1. Identify educational opportunities in coastal communities
2. Identify and develop workshops on particular mariculture opportunities.
    a. Conduct a workshop on seaweed identification and opportunities in southeast Alaska, Seward and Kodiak.
3. Provide training opportunities in multiple aspects of farms or enhancement operations
    a. Assist with business plan development.
    b. Develop demonstration farms for seaweed and shellfish mariculture.
4. Identify mechanisms for technology transfer to interested entities.
    a. e.g. red king crab
    b. kelp
5. Integrate mariculture into STEM education.
6. Investigate possibility of personal use oyster mariculture (gardening), including regulatory issues.

# Recommendations of the Workforce Development Advisory Committee

Prepared by the Workforce Development Advisory Committee for the Mariculture Task Force
June 19, 2017

The Alaska Mariculture Task Force Workforce Development Advisory Committee met four times between October 2016 and May 2017 to identify ways to support workforce development in the state's mariculture industry and develop recommendations to address challenges. Members and contributors included: Paula Cullenberg, Alaska Sea Grant, chair; Eric Wyatt, Blue Starr Oyster Co.; Jim Aguiar, Eagle Shellfish Farms; Myrna Gardner, Central Council Tlingit Haida Indian Tribes of Alaska (CCTHITA); John Kiser, Rocky Bay Oysters; Tomi Marsh, OceansAlaska; Reid Brewer, UA Southeast; Julie Decker, AFDF; Adam Smith and Christi Colles, Alaska Department of Natural Resources; Barbara Brown, Dept. of Labor and Workforce Development; Sam Rabung, Alaska Department of Fish and Game; Kirsten Shelton Walker, McDowell Group.

**Objectives for Workforce Development**

The group identified three objectives for workforce development in the mariculture industry:

1. Increase profits and business success for those already in the industry;
2. Ensure hatcheries and nurseries and farms have a skilled workforce to draw from;
3. Inform, recruit and retain new entries into the industry.

**Alaska Mariculture Workforce Development Advisory Committee Recommendations:**

1. Encourage the hire of a Mariculture Specialist.
2. Develop and circulate mariculture skill-building resources. Offer professional development to growers, available remotely and in-person.
3. Offer an intensive, hands-on "Introduction to Shellfish/Seaweed Farming" boot camp.
4. Develop a mariculture apprenticeship/mentorship program.
5. Participate in industry career awareness/career exposure activities.
6. Evaluate and track participant progress. Include mariculture workforce impacts in economic and employment analyses.

**Alaska's Mariculture Workforce**

Direct employment at aquatic farm operations in Alaska includes owners, partners, employees, interns and family members. Paid positions can include part time, full-time, seasonal and year round. Most operations include volunteers, family members or interns to help keep labor costs down. Hatchery and nursery operations generally use paid full-time and seasonal employees.

In 2015, 138 people were working at shellfish farms; 55 were paid employees. Paid positions, including laborers, participated in 3,500 workdays (average 63 days or 12-13 weeks) and total workdays (including non-paid owners, etc.) were 9,600.

Hatchery and nursery operations had 36 workers; 3,420 days of paid workers (average 95 days employment or 23 weeks). Eleven positions worked more than 150 days and 92% of the positions were reported as laborers. Overall seed supply employment opportunities grew in 2015 with an increase in number of workers and number of days working.

Workforce development is needed for new operators, workers at farms, and hatchery workers. Skills needed by mariculture operators include: growing, harvesting, processing, marketing, meeting regulations and financial management.

In 2014, the Alaska Maritime Workforce Development Plan for the state was published. Shellfish farmers surveyed during the development of the plan identified the following action steps to expand the workforce:

- Increase awareness about small business loans to support entrepreneurs, by providing information about what loans are available and points of contacts and other references that can provide access to capital.
- Provide access and support for financial management and business training.
- Explore the need for a program similar to the reduced loan fee incentive for an Alaska Housing Finance Corporation loan, linking financing to financial training.

Challenges to the shellfish/seaweed farming workforce, identified by the Advisory Committee include: remote and often isolated farm locations, intense work condensed into a small season, physically demanding and repetitive work, outdoor work in all weather, low wages if an employee and/or small business owner responsibilities.

The Advisory Committee identified the need to target key populations such as Alaskans used to weather conditions, veterans, fishermen, and rural youth to meet workforce needs. Since Alaska would like to see the mariculture industry grow, incentives and workforce development programs should be developed to encourage more Alaskans to follow this career pathway.

**Current workforce training and education**

Mariculture farmers in Alaska are not required to have any particular certification or training to operate their businesses. Hatchery workers often have some level of post-secondary education, although that requirement is not consistent in Alaska. However, training and professional development is a critical part of recruiting a quality workforce and ensuring self-employed farmers gain the most value from their businesses. Currently, there are some, but limited, opportunities for professional development and training in mariculture in Alaska, listed below. Some training is offered in other states and a brief overview is provided here.

Alaska Sea Grant (UAF) offers workshops, technical assistance and training for Alaskans on a wide range of coastal issues and hosts an aquaculture website which is a good resource site for beginning and current farmers. For many years, Ray RaLonde served as a statewide Aquaculture Specialist for the Alaska Sea Grant's Marine Advisory Program. RaLonde worked with the shellfish farming industry on training, permitting, researching best growout practices and market opportunities. He retired in October 2015 and his position has not been refilled due to budget restrictions.

UAS offers an occupational endorsement, a certificate and an associate degree in Fisheries Technology that targets technicians at salmon hatcheries or fisheries technicians at state or federal agencies. While the program has offered a shellfish farming class in the past, it currently has no directed program focused on mariculture.

Training materials developed both by RaLonde and by UAS' one class on shellfish farming are available as well as module outlines developed by shellfish farmer, John Kiser. As of this writing, there is no capacity to teach any shellfish or seaweed farming training classes in Alaska.

The Virginia Institute of Marine Sciences has an Oyster Aquaculture Training Program http://www.vims.edu/research/units/centerspartners/abc/oat/index.php Participants rotate through the stages of oyster aquaculture from the hatchery to field grow out operations. Brief classroom lectures on major topics provide background information. This program will also include field trips to other research facilities and industry sites.

The Oyster Aquaculture Training (OAT) program is funded by non-State private funding. It offers prospective shellfish aquaculturists an opportunity to learn about all aspects of oyster culture, from hatchery to field operations—essentially, it is oyster culture "boot camp." In the past, many of these trainees have ended up in local businesses, and some have gone far afield. Consideration is afforded to all applicants who demonstrate a desire and aptitude for oyster aquaculture. The program draws from a national pool.

Maryland Extension has a broad suite of classes: http://extension.umd.edu/aquaculture/educational-programs Maine Sea Grant has extensive seaweed culture resources, other Sea Grant programs around the country have a range of aquaculture resource materials.

Roger Williams College, through instructor, Dale Leavitt also teaches a beginning shellfish growing class. In 2016, Leavitt offered the class via distance for the first time.

**Alaska Mariculture Workforce Development Advisory Committee Recommendations:**

**1. Encourage the hire of a Mariculture Specialist.**

The Advisory Committee noted the lack of capacity dedicated to developing the shellfish/seaweed farming workforce in Alaska. A Mariculture Specialist would be a catalyst for workforce development including: fine-tuning training materials, develop and coordinate training opportunities to meet workforce objectives. The Committee recommends that the Mariculture Specialist be part of Alaska Sea Grant's Marine Advisory faculty due to Sea Grant's connections with industry and the ability to help direct industry-driven research.

**2. Develop mariculture skill-building resources. Offer professional development to growers, available remotely and in-person.**

Class curricula, training modules and skill building resources have been developed over the years in Alaska. However, some are out of date and somewhat difficult to assemble. These teaching materials need to be updated, loaded online and made available remotely, as professional development to farmers and advancement for farm workers throughout the year. Hands-on, in-person training should be made available to farmers at annual meetings and on site as resources permit. While recognizing that University credit or a degree is not needed to be successful in mariculture, the value of some sort of University "credentials" should be explored.

**3. Offer an intensive, hands-on "Introduction to Shellfish/Seaweed Farming" boot camp.**

The objective of the hands-on "boot camp" is to provide an intensive, real world exposure to mariculture as a career. While some participants will choose not to pursue mariculture, others may become a cohort of Alaskans who could either work on a farm or eventually start their own farms. The "boot camp" will be a partnership with Central Council of Tlingit and Haida Indian Tribes of Alaska, other tribal workforce programs, Alaska Sea Grant, growers and other partners.

**4. Develop a mariculture apprenticeship/mentorship program.**

Some progress has been made in developing a mariculture apprenticeship program in Alaska. A traditional apprenticeship program, sponsored by the Alaska Department of Labor and Workforce Development, requires a step-wise plan for advancement as well as a link to formal training program. This may or may not be possible on a small, potentially remote shellfish farm. An informal apprenticeship or mentorship program supported with tribal workforce funds or by other means such as gradual development of a farm site may also be developed and could prove more flexible for a small business owner. Without federal apprenticeship funds available, other resources will need to be available to support a program, i.e. favorable loan terms for example. Once developed, an apprenticeship/mentorship should link to the "boot camp" and result in some type of certificate of completion to document skills.

**5. Participate in industry career awareness/career exposure activities.**

Numerous high schools in coastal Alaska incorporate career awareness into their education programs. Mariculture as a career opportunity should be included. Information describing this career, the pros and cons of the job, potential earning and an educational pathway should be developed and shared with high schools as well as made available more broadly online. Maritime Works and the University of Alaska's Fisheries, Seafood and Maritime Initiative both have websites developed to provide information on maritime careers. The Future Farmers of Alaska has had a mariculture strand intermittently, coordinated by Alaska Sea Grant and FFA. This structured hands-on mariculture career exposure as well as other hands-on programs should be encouraged.

**6. Evaluate and track participant progress. Include mariculture workforce impacts in economic and employment analyses.**

With Alaska's current small mariculture workforce, it should be simple to track the progress of participants in workforce training programs. This will enable the programs to be evaluated and improved. It will also enable Alaska to more fully understand and describe the workforce. Economic and employment analyses often underreport or leave out mariculture operators altogether due to lack of information. More clearly describing the workforce enables the true value for the industry to be described.

Potential Workforce Development partners: Central Council Tlingit and Haida Indian Tribes of Alaska, Haa Aani, Alaska Sea Grant, Alaska FFA, Alaska Shellfish Growers Association, University of Alaska Southeast Fishery Technology Program.

# APPENDIX F - *Economic Analysis to Inform the Alaska Mariculture Initiative: Phase 1 Case Studies*

## Executive Summary

The potential economic impact of a fully developed mariculture industry in Alaska is not well understood by industry or policymakers. It is also not entirely clear what is needed to move from Alaska's current micro industry to a fully developed industry. The Alaska Fisheries Development Foundation (AFDF) has been awarded a grant from NOAA in order to spearhead the Alaska Mariculture Initiative (AMI) with the following goals: (1) expand the stakeholder base, create partnerships, and increase capacity to be effective; and (2) develop a clear and comprehensive strategic plan, including a written commitment to implement the plan by the various stakeholders and agencies. Northern Economics, Inc. was contracted by AFDF to conduct an economic analysis to help inform decisions to be made in the creation of the AMI strategic plan. The economic analysis will contain three phases:

- Phase I: Comparative case studies which outline examples of successful mariculture industries in different regions of the world.
- Phase II: Preliminary economic analysis to support the development of a statewide strategic plan.
- Phase III: Analysis of the costs, benefits, and economic impact of the statewide strategic plan developed as part of the AMI.

This report represents the work completed for Phase 1. Funding for Phases II and III is pending.

In this report we describe nine case studies. Drawing on existing literature, each case study includes (1) a description of the industry; (2) the current economic impact of the industry, (3) the history and reasons for the industry's growth, as well as past and current obstacles to growth; (4) best available estimates of private and public investments in order to reach current levels of development; (5) estimates of costs and benefits of the return on investment in these regions; and similarities and contrasts to Alaska (e.g., workforce, transportation, government support programs) and relevance and applicability of the industry's experiences to Alaska. Case studies completed include:

- Alaska salmon enhancement
- Alaska king crab enhancement
- Washington geoduck
- Florida hard cams
- Ireland Seaweed
- Spanish mussels
- Prince Edward Island mussels
- New Zealand mussels
- British Columbia First Nations aquaculture

These case studies provide insights into best practices in development of strategic mariculture initiatives, and attributes and characteristics (such as access to markets, employment base, government and public support, etc.) that have led to the success of mariculture development in other parts of the world. These factors can be compared to the current social, economic, regulatory, investment and political climate in Alaska to allow for efficient and effective development planning and implementation. The following subsections provide brief descriptions of each case study.

**Alaska salmon enhancement**

In response to precipitous declines in salmon harvests in the 1950s and 1960s, the State of Alaska initiated its salmon fisheries enhancement program in 1971. In that year, the state legislature created the Division of Fisheries Rehabilitation, Enhancement and Development within the Alaska Department of Fish and Game and tasked the division with planning the rehabilitation, enhancement and development of all aspects of the state's fisheries to insure perpetual and increasing production and use, and encourage investment by private enterprise. Perhaps the most distinctive feature of Alaska's salmon fisheries enhancement program is that most hatcheries in the program are owned and operated by private, nonprofit "regional associations" comprised of commercial, recreational and subsistence fishermen, seafood processors, conservationists, and local civic interests. A 2008 economic impact analysis estimated that hatchery operations and the commercial harvesting and processing of salmon produced by three regional associations in southeast Alaska produced $233 million in total (direct, indirect, and induced) economic output and generated a total of 1,192 jobs and $59 million in labor income.

**Alaska king crab enhancement**

The Alaska King Crab Research Rehabilitation and Biology program was established in 2006 with the mission of understanding the large-scale culturing needs of red and blue king crab, and perfecting strategies for hatching and rearing these species to a stage where they can be released into the wild and contribute to reversing low wild stock abundance in Alaska. Acquiring this knowledge base will aid policymakers in making informed decisions about whether to pursue active rehabilitation of Alaska's long-depressed wild king crab stocks through hatchery enhancement. Several more years of developmental research are probably required before a full-scale hatchery-enhancement operation is feasible. Once initial cultivation and releases have occurred, at least another seven years will be required before released crabs grow to sizes that could be recaptured, and the success of a rehabilitation and enhancement program can be determined. Therefore, any potential economic benefit from a king crab enhancement program is at least 10 to 15 years off in the future.

**Washington Geoduck**

The commercial dive harvest of geoduck began in the early 1970s as a managed fishery producing a relatively low value product (< $1 per pound [lb]). However, by the early 1990s a developing market in Asia transformed geoduck into a much higher valued product. These initial steps led to successful development of commercial geoduck aquaculture in the State of Washington and a significant expansion of production volumes and values for both cultured and dive harvested geoduck. Challenges remain, however, with continual demand for hatchery-produced geoduck seed, slow growth, and an ongoing presence of Paralytic Shellfish Poisoning contamination. Nevertheless, the future growth of the industry looks promising, especially for growers interested in the long-term production of a high-value product. Aquaculture production has increased significantly over the last 20 years from zero pounds in 1995 to over a million pounds since 2008. The average yearly value of production (2003–2012) is over $10 million, with 2012 recording a record value of $16,432,111.

**Florida hard clam**

Hard clam aquaculture began in Cedar Key following the ban on the use of gill nets in Florida state waters. As a result many commercial fishermen were out of work. Clam culture training was begun to offer new employment opportunities and train fishermen to become aquatic farmers. In addition, shellfish aquaculture

leases were identified, permitted, and marked, allowing for placement of trainees onto farm sites in Cedar Key and other coastal areas of Florida. These measures resulted in a rapid expansion of clam aquaculture. Statewide production in 1987 was about 100,000 lb. By 1999, 351 growers produced over 4.5 million pounds of farm production. Corresponding farm gate sales have also increased, with the value in 2012 reported at $38.7 million. Although the hard clam industry endured challenging events, such as the 2004 and 2005 hurricane seasons, the 2007–2012 recession, and the 2010 Deepwater Horizon oil spill, the industry exhibits a resiliency that allows for recovery and continued future market expansion. Associated with the increased shellfish farming activity was the development of spin-off businesses in support of the industry. Farm expansions also led to an increased level of public and private sector research on a broad range of issues, including market expansion, genetics, diseases and the possible culture of other shellfish species. Currently, clam farming is a mature industry in Florida, and an excellent example of a successful and community driven transition from an at-risk fishery dependent culture.

**Ireland Seaweed**

As part of the Sea Change strategy (and with the support of the Marine Institute and the Marine Research Sub-program of the National Development Plan, 2007–2013) a project was carried out to develop and demonstrate the viability of cultivation methodologies for seaweed species with known commercial potential. This project was led by the Bord Iascaigh Mhara (Irish Sea Fisheries Board or BIM) and involved two universities and six enterprises. The project operated from 2008–2011 and aimed to farm three commercially important species, Palmaria palmata, Laminaria digitata, and Porphyra sp. This project has proved to be pivotal in development of the industry, as it identified crucial data that ensures strategic investment. It clearly demonstrated that brown seaweeds (kelp) can be farmed, and provided business plans and economic analyses for hatchery and grow-out businesses. The project concluded that the price for brown seaweed (off the farm) needs to be about $1,275/wet metric ton to be profitable. The project also highlighted the limitations for farming Palmaria, and concluded that currently farming Porphyria is not viable. The funding required to make this project possible is not publicly available information. Through coordinated and focused industry development led by BIM, seaweed aquaculture in Ireland is now a viable but fledgling industry. Going forward, the main obstacle will be labor costs. Development of mechanized seaweed cultivation will be required to achieve cost objectives.

**Spanish mussels**

Mussel raft culture originated in the Mediterranean region of Spain (Barcelona) in the early twentieth century. The number of floating raft farms established in the Galician rıas experienced growth from 10 rafts in 1946 to over 3,300 in 1997. During this 30-year period, there were a large number of lease areas granted, mostly to family entities which owned one or two rafts each. The number of rafts has stayed the same for nearly 40 years, with raft size increasing from about 2,691 to 5,382 square feet, and culture ropes from 33 to 39 feet long through the 1990s. Since production has reached its maximum levels in Spain, some of the original companies have established operations in Chile, where they grow 8,000–10,000 tons of mussels per year (with a production capacity of 30,000 tons) and export frozen mussel meat and mussels on the half shell. The mussel raft aquaculture industry in northwest Spain grows an annual crop of over 200,000 metric tons, and is the second largest mussel farming area in the world behind China. The industry is composed of approximately 3,300 rafts with a production as high as 75 tons per raft. Production has maximized since the early 1990s, and there have been no additional rafts or lease sites since 1976. The economic impact of mussel aquaculture, in the growing, services, and processing sectors in terms of jobs and value makes it a very valuable component of the sustainable economic activity in Galicia.

**New Zealand mussels**

The New Zealand aquaculture industry began in the mid-1960s with marine farming of oysters and then mussels, typically by small, innovative operations. It quickly established a domestic market and began making inroads into export markets in the 1970s. As aquaculture techniques and value chains became more sophisticated in the 1980s, small owner-operator farms became less common and aquaculture/seafood-related companies expanded and consolidated. There are now approximately 645 mussel farms in New Zealand over seven major regions. Production efficiency, control of stock, and cost reduction dominated industry thinking as export markets expanded. During the 1990s global competition in seafood products intensified, driving further consolidation of the industry in an attempt to achieve increased production and marketing efficiencies. With the introduction of the Resource Management Act in 1991, the expanding industry began to focus on sustainable production, acknowledging its associated environmental and social issues. In 2011, New Zealand produced 101,000 tons of mussels, worth $197 million, providing three-quarters of the country's seafood export value. The New Zealand mussel industry has developed over 30 years to become the world's leader in efficiency of mussel farming technologies, value added processing, and mussel research and development.

**Prince Edward Island mussels**

Prince Edward Island (PEI) mussel production has not grown much since 2000, when landings were nearly 18 million lb. Most of the growth of the industry took place between 1986 and 2001 due to skilled entrepreneurs. During the last decade, there has been consolidation of numerous smaller operations resulting in five large companies with an economy of scale. The utilization of long-line technology allowed for efficient seeding and harvesting, and adaptation to the relatively shallow waters in the enclosed PEI bays. Canada (and the maritime provinces) benefit from a strong federal aquaculture development policy, regional development centers, and financial support for outcome-based research and development. Mussel leases account for a total of 10,932 acres. In 2013, PEI produced 22.9 million pounds of mussels with a farm gate value of $29.43 million. Prince Edward Island's aquaculture industry contributes significantly to the PEI tax base, contributing $24 million in gross value added to local economies annually. The industry is also a vital component of the Island economy providing approximately 2,500 direct and indirect jobs. Many of these jobs provide year-round employment in local rural communities.

**British Columbia First Nations aquaculture**

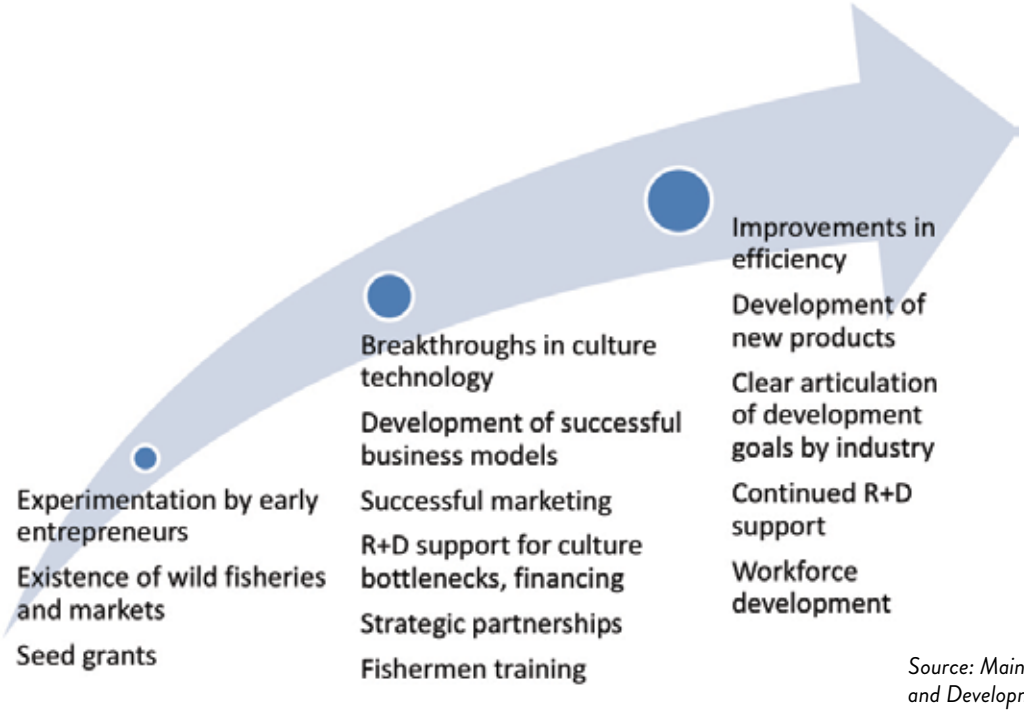
Canada's First Nations communities are uniquely positioned to benefit from aquaculture due to hunting, fishing and gathering rights, and access to aquaculture development sites. In many cases, the necessary skills and infrastructure for aquaculture development already exist because of past involvement in traditional fisheries. There are currently 50 Aboriginal groups across Canada that have developed aquaculture business ventures and partnerships, with many more expressing interest and a desire to get involved in new aquaculture sector opportunities. In British Columbia, 21 First Nations are engaged in shellfish aquaculture activities and 14 First Nations are engaged in finfish aquaculture. There are currently 56 different species of finfish, shellfish and aquatic plants commercially cultivated, generating about $1.81 billion in total economic activity, much of which takes place in rural and coastal communities. Immediate opportunities exist for further development of finfish, shellfish and freshwater aquaculture endeavors, with additional longer-term opportunities for species such as geoduck, scallop, sablefish, sea cucumber and rockfish, where culture technology is under development.

During the process of this investigation we have identified key elements for sustainable mariculture development—necessary factors in the success of mariculture development around the world. Figure ES-1 illustrates these elements and which case studies contain them. Figure ES-2 further illustrates the elements observed in the successful growth over time of the mariculture industries in the case studies reviewed.

*Figure ES-1. Key Elements for Sustainable Mariculture Development*


*Source: Maine Shellfish Research and Development, 2015*

*Figure ES-2. Elements of Successful Mariculture Industry Growth*




*Source: Maine Shellfish Research and Development, 2015*

# Executive Summary

The Alaska Fisheries Development Foundation contracted with McDowell Group to develop an economic framework for Alaska mariculture industry development. This framework, based on analysis of the current industry and potential industry growth scenarios, is designed to inform the Alaska Mariculture Task Force's comprehensive planning process and establishment of a more viable and sustainable industry.

## Key Findings

### *Oysters dominate today's Alaska mariculture industry. Potential is growing for other species.*

- Alaska mariculture industry today is focused on four main species: Pacific oysters, blue mussels, geoducks, and sugar kelp.
- Alaska mariculture production is dominated by oysters, accounting for over 90 percent of Alaska aquatic farm sales in 2015.
- Additional species with potential for mariculture/enhancement in Alaska include king crab, sea cucumbers, abalone, clams, purple-hinged rock scallops, weathervane scallops, and sea urchins.

Photo credit: Bob Koenitzer.

### *Alaska mariculture industry production and value is trending up.*

- Oyster farm size and inventory, and oyster seed inventory, are increasing in Alaska, which suggests oyster production may increase substantially in the near future.
- While current farmed geoduck harvests are minimal in Alaska, geoduck farm inventory is potentially highly valuable, with over 900,000 clams to reach harvestable size over the coming decade.
- Most mussel production and sales in Alaska are incidental, as farmers of other species harvest mussels that naturally set on their gear. Mussels may serve as a source of supplemental income on oyster farms. In-state demand for mussels appears robust, and well above current production, at potentially 70,000 pounds or more annually.
- Kelp farming is just developing in Alaska, with harvests beginning in 2017 and one large-scale seaweed buyer operating in the state. Permit applications for 2017 indicate increasing kelp production on the horizon.

***Seed security, profitability, regulations, market access, and data/information needs are critical challenges to industry growth.***

The Alaska mariculture industry is small in scale, at approximately $1 million in output, relative to Alaska's commercial fisheries and seafood processing sectors and to mariculture industries in other states and nations. Investment in overcoming these hurdles for the industry will require a balance of private and public resources.

**SEED SECURITY**

- Investment, perhaps through public/private partnerships, in securing viable and consistent in-state sources of quality seed, particularly for oysters, kelp, and geoducks is critical for industry growth.

**OPERATING COSTS/PROFITABILITY**

- Start-up costs, financing constraints, long product grow-out times, logistical challenges in remote locations, and regulatory factors are some of the many challenges that can result in expenses that challenge the profitability of many operations.

**REGULATIONS**

- No Alaska statutes currently authorize shellfish stock restoration, rehabilitation, or enhancement other than for research.
- Some State regulations impacting mariculture operations are not aligned with operating realities, such as long product grow-out times.
- Seaweed-specific permitting needs revision.

Photo credit: NOAA.

**ACCESS TO MARKETS**

- Most Alaska mariculture product is currently sold to in-state markets. Growth will require much greater market penetration outside of Alaska.
- To reach out-of-state markets, Alaska farmers will need to provide a dependable supply of high-quality product, utilize affordable transportation options to reach markets, and develop capacity to produce product forms, such as frozen product, suitable for lower-cost transport to more distant market.

**INFORMATION NEEDS**

- Reliable access to data on environmental conditions, product growth factors, economics, and food safety considerations (such as PSP) allows users to analyze sites for productivity, conflicting uses, and efficiency and more effectively plan and operate businesses.

***A balance of public and private investment focused on overcoming key industry challenges can position the Alaska mariculture industry for expansion in the coming decades.***

- While private investment in mariculture will be critical to industry growth, some required investment, such as hatchery development to enhance seed security, or to support king crab hatchery R&D, does not or may not offer the profit incentive needed to attract private investment.
- Government support for the industry, such as that which has resulted in mariculture industry expansion in other countries and can lead to private investment, is essential for the industry to expand at a pace and scale commensurate with its full potential.

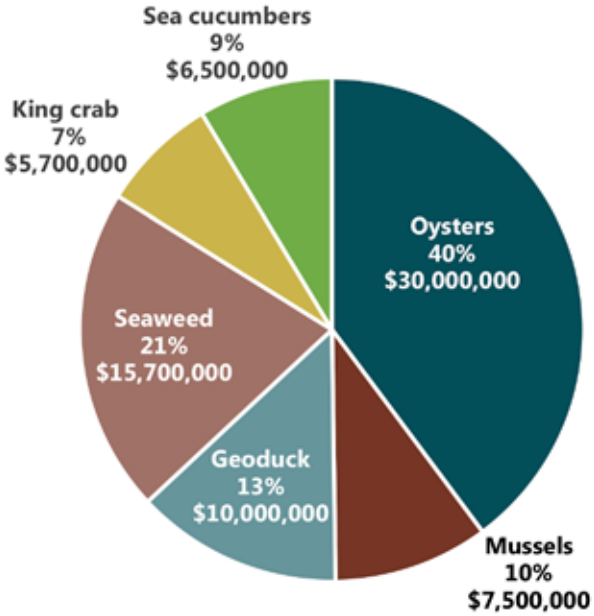
***With strategic investment in overcoming current challenges, the Alaska mariculture industry could grow to a $100 million industry in the next 20 years.***

- Species with greatest mariculture development potential (both farming and enhancement) in Alaska in the next 20 years include oysters, mussels, geoduck, kelp, king crab, and sea cucumbers.
- The economic framework outlined in this report establishes 20-year revenue and production goals that result in $105 million in annual output, including all direct, indirect, and induced effects.
- This 20-year goal includes $75 million in industry sales and an employment impact of 1,100 direct jobs and 1,500 total jobs.

**Long-Range (20-Year) Annual Production Goals**

- Pacific oysters (count): 45 million
- Geoducks (count): 500,000
- Kelp (lbs./wet): 19.2 million
- Kelp (lbs./dried): 2.9 million
- Blue mussels (lbs.): 1.8 million
- Red king crab (lbs.): 565,000
- Sea cucumbers (lbs.): 1.9 million

**Twenty-Year Annual Revenue Goals**




- At 20 years, annual labor income would include approximately $38 million in direct wages and a total of $49 million in direct, indirect, and induced labor income.
- 30-Year output associated with goals in this economic framework is projected at $274 million, while 50-Year output totals $571 million.
- This analysis concludes with a table of priority investments to grow the mariculture industry.

# APPENDIX H - *Existing Research & Future Needs*[1]

Prepared by the Research, Development and Environmental Information Advisory Committee
for the Mariculture Task Force
February 18, 2018

**Mariculture definition**
For the purpose of this plan, mariculture is defined as enhancement, restoration, and farming of shellfish (marine invertebrates) and seaweeds (macroalgae). Finfish farming is not legal in Alaska waters, and therefore, it is not considered in this report.

A more detailed description of mariculture is that it is the cultivation of aquatic organisms in marine waters of the state and state-owned tidal and submerged lands. It includes cultivation of shellfish, other invertebrates and aquatic plants or any stage of their life cycle, held in captivity or under positive control, that are sold or offered for sale by an individual or corporate entity. It also includes cultivation of organisms, excluding finfish, for the purpose of restoring or enhancing an existing fishery use (i.e. commercial fishery, sport fishery, personal use fishery, and subsistence fishery) and will be considered a common property resource of the state. All organisms used for mariculture are indigenous to the state water or authorized to be imported into the state.

**Mission statement and define R+D**
Research and development is work directed towards the innovation, introduction, and improvement of products and processes. It usually refers to long term activities in science, engineering and technology with desired outcomes and commercial yield. Desired outcomes for Alaska Mariculture are:

1) growth and diversification of the industry,
2) fostering working waterfronts, and
3) sustainable development - achieving social and economic progress in concert with ecological support systems.

A key component of growth is efficiency, with optimal production capacity and profitability, and diversification with new farming, harvesting and processing systems, new species cultivated, and new products developed and marketed. Maintenance of the mariculture industry involves sustainability, where the ecological footprints and ecosystems interactions of current and future production systems are understood, quantified, managed and verifiable, and security, where strong risk management systems and tools protect current and future production systems from existing and emerging threats such as disease, harmful algal blooms, bacterial diseases, climate change, competition in external markets, etc. An important part of a functional research and development program is having the required expertise, either in-house or through a network of experts, and infrastructure (research labs, field stations, experimental farms, vessels, etc.).

Research and development can apply to:
Existing mariculture companies

- Improve efficiency of culture systems with technologies adapted to Alaska
- Develop new products and value from Alaskan water
- Cultivate new native species for private mariculture or fisheries
- Better understanding of market risks

Enhancement

- Increase productive capacity
- Reduce risks of disease, environmental changes, etiological agents or contaminants
- Understand how mariculture operations interact with the environment

[1] *The information listed in this document is not an exhaustive list of all relevant research that has been done with respect to mariculture in Alaska. It is a summary of what the Advisory Committee could assemble with the time and resources available.*

New companies
- Feasibility analyses for development of new aquatic farms, hatcheries, nurseries, processors, equipment, services
- Strategic partnerships

New products
- New food product forms, ecosystem benefits, wild fishery enhancement
- Biomedical, ornamentals, pharmaceuticals, cosmetics, agriculture, gear, vessels

Building capacity
- Aquaculture engineering and economics
- Biology, ecology and husbandry of cultured species
- Disease and genetics
- Marine sciences and oceanography focused on mariculture outcomes
- Food processing and value-added product development
- Workforce development (especially with respect to husbandry, and technology transfer)

The mission of the Research, Development and Environmental Information Advisory Committee of the Mariculture Task Force is to
- review existing mariculture environmental information and R+D needs in Alaska,
- evaluate the expertise and infrastructure within Alaska in both the public and private sectors for mariculture R+D and
- do a gap analysis of what is needed to achieve the desired goals in the short term (1-2), medium term (3-5) and long term (5-10).
- establish a framework for the coordination of mariculture development at the state and federal level, with concept development for a mariculture research center at the University of Alaska.

**Existing Aquatic farms in Alaska**

**Background:** With the enactment of the Aquatic Farm Act in 1988, the Alaska Departments of Natural Resources (DNR) and Fish and Game (ADF&G) implemented regulations for aquatic farming of shellfish and aquatic plants. Use of tide and submerged land is authorized by DNR to support aquatic farming operation activities. DNR balances aquatic farm development with public and upland owner access, navigation of public waters, and traditional uses of the area.

ADF&G currently issues permits for aquatic farm, nursery, and hatchery operations; stock acquisitions and transports; seed source health examinations and approvals; and collection of annual operation activity data including production and sales data. Statutes, regulations, and policies for aquatic farm and hatchery activities provide for industry development while protecting established fishery uses and the state's fish and wildlife resources and their habitat. Permitted operations must use managed cultivation practices that are technically and operationally feasible and they must demonstrate that they are contributing to the economy and well-being of the state.

**Current Industry Status:** As of the date of this document, the shellfish and aquatic plant aquatic farming industry in Alaska is comprised of 56 aquatic farms, 7 nurseries, and 3 hatcheries based on the number of operation permits issued by ADF&G.

Operators are required to complete aquatic farm annual reports and submit to ADF&G summarizing their activities for the previous year. The reports are due January 31 each year. For 2016, the overall sales of shellfish and aquatic plants for all permitted operations, including seed suppliers totaled $1.2 million. Approximately 29 (32%) of the aquatic farm operations had sales and sold over 1.32 million Pacific oysters, 42,695 lbs of Pacific geoduck, and 4,975 lbs blue mussels, with a total farm gate value of $1.23 million. Regionally, Southern

Southeast operations had over 52% of all sales statewide, followed by Kachemak Bay (31%), Prince William Sound (14%), and Northern Southeast (3%). Seed suppliers produced approximately 11.9 million juvenile Pacific oysters, a 25% increase from the previous year. Seed sales decreased by 13% and totaled $231,469.

Table 1 provides a consolidated list of approved organisms currently permitted to be cultured at aquatic farm, nursery, and hatchery operations in Alaska.

Table 1: List of organisms approved to be cultured on permitted operations

| Site Type | Approved on Operation Permit |
|---|---|
| Aquatic Farm and Nursery Operations | Shellfish: Pacific Oyster, Pacific geoduck, Blue Mussel, Littleneck Clam, Purple-Hinged Rock Scallop, Pink Scallop, Spiny Scallop, Cockle, Green Sea Urchin, Purple Sea Urchin, Red Sea Urchin, Sea Cucumber<br><br>Macroalgae: Sugar Kelp, Giant Kelp, Ribbon Kelp, Bull Kelp, Three-ribbed Kelp, Nori, Red Ribbon, Sea Lettuce, Dulse |
| Hatchery Operations | Shellfish: Pacific Oyster, Blue Mussel, Geoduck, Littleneck Clam, Purple-Hinged Rock Scallop, Cockle, Pacific Razor Clam, Butter Clam<br><br>Macroalgae: Dark Sea Lettuce, Dulse, Kombu, Nori, Ribbon Kelp, Sea Lettuce, Three-ribbed Kelp, Sugar Kelp, Bull Kelp |

**Current Aquatic Farm Inventory:** At the end of 2016, 47 aquatic farms reported having inventory. Pacific oyster made up 87% of all aquatic farm inventory and totaled 9.8 million oysters (Table 2). This is a 30% increase from the previous year. The remainder of the inventory included approximately 2 million blue mussels and 857,425 Pacific geoducks (Table 2). New seed stock obtained in this year, made up 52% of the aquatic farm inventory. Estimates for blue mussel and Pacific geoduck inventory were reported to decrease from 2015.

Table 2: List of organisms making up inventory at permitted aquatic farms at the end of 2016[1]

| Species Name | No. of Farms with Inventory | No. of organisms |
|---|---|---|
| Pacific Oyster | 32 | 19,818,695 |
| Blue Mussel | 5 | 2,014,697 |
| Geoduck | 14 | 857,425 |

Pacific oyster seed inventory for hatchery and nursery operations reached the highest ever recorded at 31.4 million, an increase of 204% from 2015.

**Organisms Applied for in Applications:** Table 3 provides a list of organisms proposed to culture on all aquatic farming applications from 1988 to present.

| Table 3 List of organisms applied for in applications from 1988 to present | |
|---|---|
| Site Type | Organisms |
| Aquatic Farm | Shellfish: Blue King Crab, Red King Crab, Blue Mussel, Butter Clam, Cockle, Pacific geoduck, Littleneck Clams, Pacific Oyster, Pacific Razor Clam, Weathervane Scallop, Pink Scallop, Purple-hinged Rock Scallop, Spiny Scallop, Pinto Abalone, Tusk Shell, Green Sea Urchins, Purple Sea Urchin, Red Sea Urchin, Sea Cucumber, Sea Star<br><br>Macroalgae: Bull Kelp, Laver, Dark Sea Lettuce, Dulse, Giant Kelp, Kombu, Nori, Red Ribbon, Ribbon Kelp, Sea Lettuce, Three-ribbed Kelp |

**Organisms Reported as Inventory Historically:** Table 4 provides a list of organisms reported as inventory at all operations from 1990 to present.

| Table 4: List of organisms reported as inventory at all operations from 1990 to present[1] | |
|---|---|
| Site Type | Organisms |
| Aquatic Farm | Shellfish: Blue Mussel, Pacific Geoduck, Green Sea Urchin, Littleneck Clam, Pacific Oyster, Pink Scallop, Purple-hinged Rock Scallop, Spiny Scallop<br><br>Macroalgae: Bull kelp, Ribbon Kelp, Sugar Kelp |

**Organisms Reported as Produced and Sold Historically:** Table 5 provides a list of organisms produced and sold at aquatic farm operations in Alaska from 1990 to present.

| Table 5: List of organisms produced and sold at aquatic farm operations from 1990 to present[1] | |
|---|---|
| Site Type | Organisms |
| Aquatic Farm | Shellfish: Blue Mussel, Pacific Oyster, Pacific geoduck, Littleneck Clam<br><br>Macroalgae: None |

[1] *All data that are from less than 3 aquatic farm operation permits are considered confidential by ADF&G.*

**Mariculture Economics**

A recent report by the McDowell Group (Alaska Mariculture Initiative Economic Analysis to Inform a Comprehensive Plan - PHASE II https://www.afdf.org/wp-content/uploads/AMI-Phase-II-Final-Nov2017.pdf) contains relevant information on the status of mariculture in Alaska. This report is a good beginning, and it is our recommendation that this report be updated annually. In addition, the state or some other entity should develop a method of tracking production (yield, value, trends, workforce FTE, etc.), production costs (trends, scale effects, etc.), and regional impacts (employment, expenditures, etc.) in order to assess progress over time toward the development goals.

The Alaska Department of Fish and Game Aquaculture Section tracks annual production volume, sales value, and employment for shellfish farms, nurseries, and hatcheries in Alaska. Farm gate value of Alaska's shellfish farm sales was $867,785 in 2015, a 1% decrease from 2014[2]. Farm gate value reflects an interplay between production decisions by aquatic farmers and unit prices, which are strongly influenced by global markets. Relative to 2015, oyster production volume decreased by 3% while unit price increased by 3%; production volume of blue mussels increased by 74% but price decreased by 8%; no geoduck sales were reported in 2015. Consistent with previous years, over three-fourths of the 2015 farm sales came from Alaska's 6 largest aquatic farms and fewer than half of all farms reported sales. Total paid employment in this sector remains very low, at about 37 FTE.

There are many avenues of economic, bioeconomic, and economic development research that could contribute to the growth of Alaska's shellfish farm sector. Much of the work could be undertaken by faculty in the UAF Department of Economics, the UAF School of Natural Resources and Extension, the UAF Department of Fisheries, UAA ISER, by economists at DCCED, or through contract. Examples of needed research include:

- Development of a web-based break-even analysis planning tool that can be used to explore how the effects farm scale, production intensity, scope, and location affect financial viability of shellfish mariculture operations.
- Development of regional and social impact models to highlight the role of aquatic farms in local and regional economies.
- Development of risk management tools to integrate consideration of production risk (survival, growth, etc.) and financial risk (input costs, price volatility, etc.)
- Development and identification of strategies for management of production and price risk.
- Studies to explore role of horizontal and vertical integration or coordination as mechanisms for developing stronger markets, reducing input factor costs, and mitigating risk.
- Outlook and trends for product prices.

**Environmental information relevant for Alaska Mariculture**

The growth rate, survival and profitability of Alaska mariculture products (private shellfish, macroalgae, public stock enhancement) depends upon key environmental variables which are related to ecosystem productivity and the optima for each species. These include physical parameters (water depth, bottom sediment type, wave climate, current speed, current direction, water temperature, photosynthetically active radiation (PAR), and light attenuation coefficient Kd), chemical parameters (chlorophyll a, salinity, pH and aragonite saturation, concentration of nitrate, nitrite, ammonium, phosphate and silicate, dissolved oxygen, colored dissolved organic matter, CDOM), water quality parameters (fecal coliform bacteria, occurrence of toxin-producing phytoplankton, Vibrio bacteria), and biomass of diatoms, ciliates, and dinoflagellates, micro-flagellates, total suspended particulate matter (SPM), particulate organic matter (POM), particulate organic carbon (POC)

[2] *To put this in perspective, by itself, one Washington-based company, Taylor Shellfish, anticipates farm gate sales in excess of $100 million in 2017.*

and particulate organic nitrogen (PON). Coastal geomorphology is important relative to water residence time and coastal productivity, locations of rivers and streams are important relative to water salinity and turbidity, and occurrence of wild species (i.e. shellfish and kelp beds) are important as they indicate natural habitats for existing or candidate species. Other important information includes restricted, conditional or prohibited areas (water quality), proximity to roads or towns, and traditional uses (shipping, fisheries, protected areas, native tribe uses, etc.).

The relative importance of the environmental variables which affect mariculture productivity vary between species, with temperature, salinity and exposure to waves and water velocities important for all species, dissolved inorganic nutrients are important for macroalgae, whereas water quality, the mix and abundance of toxin-producing phytoplankton, and the concentration and quality of suspended particulate matter are particularly important for bivalve molluscs.

Environmental information can be obtained through the use of periodic transects or cruises (where vertical CTD casts and water samples are taken), by using moored instruments such as temperature and salinity loggers, water quality monitors and CTD's, by using coastal water quality observing systems such as LOBO buoys, and using satellite or remote sensing of key environmental parameters such as seawater temperature, chlorophyll-a, and turbidity. Surveys of water depth and bottom type (swath bathymetry) and bathymetric and tidal gauge data can be used to develop high resolution hydrodynamic models and provide key information about water flow in and around mariculture sites, which affects growth rates of animal or plant populations and benthic impacts. Measurements made during the periods of rapid growth by the species (i.e. summer for shellfish, winter for macroalgae) provide more valuable information than those during the slow growth periods.

The environmental information listed above, and coupled with knowledge of growth rates, stocking densities and culture technologies may be used to estimate the productive capacity (how much you can grow profitably) and the environmental carrying capacity (how much you can grow sustainably) of different areas in Alaska. A list of historical and current monitoring of key environmental variables in state waters (and or models) in a GIS database would be helpful to define opportunities and gaps in oceanography which could aid in mariculture development in Alaska. These data could range from coast-wide satellite imagery to fisheries oceanographic cruises, citizen monitoring data, data obtained by growers, data collected by state and federal agencies and the tribes, and coupled with field and lab work which investigates the effects of environmental variables on growth rates and yield of different species. Information on sea state and wind velocity, especially during winter storm periods, can also be a primary component of information that affects decisions on gear types, anchoring systems, crew and product transportation routes and means, and catastrophic risk analysis.

Other important environmental information includes the presence of predators such as sea otters and sea ducks, affecting the survival of wild, cultivated, and enhanced species, as well as data on the location of species, habitats and human activities related to the approval process criteria of mariculture lease sites by the state of Alaska and federal agencies.

Near-term priorities

- Monitor for occurrence of Vibrio and biotoxins throughout mariculture areas.
- Determine what existing monitoring is occurring and planned for oceanographic data collection.

Intermediate-term priorities

- Institute a permanent water quality monitoring network employing cooperation among the university and the state and federal agencies.

Long-term priorities

- Create a statewide clearinghouse for environmental information relevant to mariculture operations.

**Ocean Acidification**

Coastal regions around Alaska are expected to experience the most rapid and extensive onset of ocean acidification (OA) compared to anywhere else in the U.S. due to water temperature, freshwater runoff, and proximity to upwelled corrosive water. Economic forecast models have estimated that Alaska coastal communities and the fisheries that support them, have a varying degree of vulnerability to OA, ranging from moderate to severe.

In the Gulf of Alaska, the NOAA Pacific Marine Environmental Laboratory has maintained a mooring off of Resurrection Bay and had a mooring near Kodiak for two years. When funds are available, NOAA-PMEL also plans to deploy autonomous gliders in OA-vulnerable coastal regions to develop a 4-D understanding of the OA conditions around Alaska. These data will be integrated with surface and subsurface pCO2, pH, temperature, salinity and dissolved oxygen data. Future goals are to combine survey collected data (2014, 2019) and autonomous data (wave gliders and Slocum gliders) to understand the spatial and temporal dynamics of carbonate mineral saturation throughout the water column.

Near-term priorities
- Identify what data is being collected
- Identify appropriate monitoring locations to support mariculture activity

Intermediate-term priorities
- Identify spatial and temporal variability in carbonate parameters
- Identify appropriate funding sources to collect and process samples

Long-term priorities
- Assess short and long term biological and economic risk to OA based on season and location
- Maintain long term monitoring

**Harmful Algal Blooms (HABs)**

Harmful algal blooms (HABs) are a challenge for the mariculture industry in Alaska, particularly for clam and oyster farming. Three types of HABs exist in Alaska, including Alexandrium spp. that produce saxitoxins and cause paralytic shellfish poisoning (PSP), Pseudo-nitzschia spp. that produce domoic acid and cause amnesic shellfish poisoning (ASP), and Dinophysis spp. that produce okadaic acid and cause diarrhetic shellfish poisoning (DSP). The Alaska Department of Environmental Conservation (DEC) regulates commercially-produced shellfish safety and tests for toxins using established protocols. HABs, primarily those that produce paralytic shellfish toxins (PSTs), result in periods when shellfish harvest is prohibited, resulting in great cost to shellfish farmers. The future growth of the bivalve mariculture industry in Alaska is heavily dependent on effective management of HABs.

An Alaska Harmful Algal Bloom (AHAB) network was formed in 2008 and provided HAB training to shellfish farmers in Southeast Alaska. This network detected a bloom event in 2011 and 2012 that is described in Trainer et al. (2014) and resulted in human illness from recreational or subsistence harvested shellfish (Knaack et al. 2016). The AHAB network was expanded statewide in 2016 and now provides information on monitoring and educational materials on their website (http://www.aoos.org/alaska-hab-network/).

Research and development needed to manage HABs
Near-term priorities
- Identify environmental conditions associated with blooms of harmful algal species
- Identify the spatial extent of blooms and oceanographic processes linking blooms in different areas
- Identify linkages between seed beds and blooms

Intermediate-term priorities

- Assess short and long term economic cost of HABs to mariculture in Alaska
- Map Alexandrium seed beds in the vicinity of existing and future shellfish farm sites

Long-term priorities

- Develop predictive models to forecast HABs
- Maintain long term monitoring

**Research on Marine Invertebrates**

Most research on marine invertebrates in Alaska has been focused on the biology, ecology and harvest of species such as crabs and other shellfish. Research on the mariculture of invertebrates has been done in the main by the Alutiiq Pride Shellfish Hatchery (APSH). The following is a summary of research and development conducted at APSH. Research on mariculture-related invertebrates by other entities is not listed here and is recognized as a significant gap in this information.

**New/alternative species**

**Littleneck clams.** ASPH has been producing littleneck clams for many years and has worked out larval culture and post set processes. Current production bottlenecks include post-set growth, as early nursery systems used for oysters (FLUPSY's, FLoating UPweller SYstems) did not work, and slow grow-out to a marketable size. Over 1 million clams were seeded at Tatitlek and other villages in Lower Cook Inlet with marginal success and growth. It was hoped this enhancement work would set the stage for aquatic farming.

**Cockles.** These are relatively easy to raise in the hatchery and have fast growth. They perform well in the nursery. They have grown well in lantern nets and can get to market size in 12-16 months using a 10mm planting. They do not foul and are a beautiful product. They can have a short shelf life and techniques will need to be worked out for live markets or investment made into value added. They have proven to be difficult to raise for enhancement because they do not like to be contained in the substrate (contrast lantern nets) and they like to move.

**Purple-Hinged Rock Scallops.** APSH has run two batches through the hatchery. They have a peculiar protracted setting process with high mortality. Ray RaLonde did some grow out trials that have been published. There is currently a Western Regional Aquaculture Center (WRAC) and NOAA project being worked on in the Pacific Northwest (PNW). There has been little interest in Alaska so we have not worked on them much. The researchers in the PNW have been working on triploidy to manage the genetics native stock issue. They also have a cementing issue that can damage gear when harvesting. There are also few marketing studies.

**Butter Clams.** APSH has grown butter clams for 2 years and has had good success. Larval rearing post-set survivals can be over 75%. They also grow very well in the hatchery and are twice the size of littleneck clams spawned around the same time. APSH was scheduled to do the first out-stocking with butter clams in the spring of 2017. One of the constraints with butter clams is their propensity to retain PSP. However, if they grow as well in the field as they have done in the hatchery, it may be a viable clam product for aquatic farming.

**Razor clams.** APSH has not raised razor clams since the EVOS project in the early 1990's. The clams performed well in the hatchery and grew like mussels. Like cockles, they did not like to be retained under culture gear. They move a lot more than was thought. It is likely that there will be more interest in razor clams for enhancement.

**Red King Crab.** APSH has been a partner with AKCRRAB in developing outstocking technology for RKC enhancement (see section below).

**Sea Cucumbers.** APSH has been working with sea cucumbers for almost 8 years. It took a while to develop the proper rearing conditions and feed regimes. Focus has been on the growth rates and the results were promising this last season. In 2015 juveniles were sent to Ketchikan and were reared by Alaska Shellfish Company. The growth rate was good. However; the survival was poor, probably due to shipping stress. The feasibility was explored of using Calcein to stain the spicules for marking. The stain has been retained for several years, is relatively easy to work with, and offers a possibility for evaluation of limited releases. Coded wire tags (CWT) and clipping were tested but did not work. In 2016 APSH sent juveniles to Ketchikan for limited out-stocking experiments. This work was conducted by Charlotte Regula-Whitefield, who also did a lot of her PhD work at APSH. Next year the feasibility of rearing juveniles in net pens will be examined with the ultimate goal to see if polyculture with salmon is feasible and/or raise them to market size in captivity. All of this work is being directly supported by SARDFA.

**Abalone.** APSH has been holding adult abalone for several years. There have been several small spawns, but no resources have been dedicated to them because of lack of interest. Pintos are a species of concern and there is possible need someday to use outstocking as a conservation measure. APSH has developed a spawning index to quantify ripening and has managed to keep the adults in a fairly ripe stage most of the year. Once kelp farming is perfected, then interest in farming of pinto abalone is quite possible. This could drive abalone spawning demand.

**Geoducks.** After many years APSH has worked out efficient cost effective techniques for raising geoducks. Unfortunately, there is limited or no demand, and geoducks have not been raised since 2015. Oceans Alaska has asked APSH to raise larvae or post set for their operation, but there is little demand at this time. Demand for Geoduck seed is also related to the consistent supply of it. There is persistent interest in farming Geoduck in AK. OceansAlaska is currently working with Alaska Sea Grant, APSH and other partners on a modest seed development project.

**Ocean Acidification Lab.** APSH operates a Burke-o-later that continuously monitors PCO2 and TCO2 in Alaskan waters. In year two of a Bureau of Indian Affairs (BIA) funded project, APSH is expanding coverage by sampling the seven villages in south central as well as samples from the Kachemak Bay National Estuarine Research Reserve (KBNERR) and Prince William Sound Science Center (PWSSC). These efforts are expected to extend to coastal communities throughout the state. We also recently completed our first CO2 dosing experiments, to change the pH and aragonite saturation level, on butter clams as a "proof of concept" to evaluate all the species we raise. Experiments have been done on littlenecks and cockles, and the data is being worked up. Similar work on razor clam larvae will be completed in July 2018. There are additional Burke-o-laters at Oceans Alaska in Ketchikan and on an AMHS ferry.

**Shellfish Sanctuaries/ Gardens.** There seem to be almost no hard-shell clams in south-central Alaska as there are only a few pockets of isolated populations in existence, There is a real need to expand survey areas. The shellfish sanctuary concept is something APSH is working on with Chugach Regional Resources Commission (CRRC) in Port Graham and Resurrection Bay. The premise is to aggregate adults into an area 1) to eliminate the allee effect, 2) to determine if the shellfish are forming gametes, when they spawn, 3) to determine if the spawning behavior is synchronous and 4) to determine the percent of the population that is spawning. A non-intrusive technique is being explored that can extract gametes without sacrificing the adult. APSH has also been working with KBNEER to determine if larval traps or other techniques might work to determine larvae transport and settling patterns. The third component is to stock juveniles in the same location to determine growth and survival. The hope is that the sanctuaries will provide a larvae sink to bring back local populations but also provide a good tool to try to see what the bottleneck is with the species.

**Molluscan Broodstock Program.** APSH had retained the progeny from the original successful crosses for Alaskan oyster families. These animals were sent to Kachemak Shellfish Mariculture Association (KSMA)

for their oyster work. There seemed to be little interest in the crosses, and growers were not willing to pay a premium for an Alaskan raised oyster. There is very real interest in the initial outstocking and developing a modest Alaskan broodstock program. However, there has been no interest in funding this by the government. The potential impact of Pacific Oyster Mortality Syndrome (caused by an oyster herpes virus) could add considerable interest in isolated Alaskan broodstock sources.

Near-term priorities
- Develop nursery systems for hard shell clams
- Increase survival to harvestable size during enhancement projects
- Partnerships with growers to culture new species
- Develop value added products

Intermediate-term priorities
- Understand life histories of native species with aquaculture potential
- Develop marking techniques for enhanced stocks
- Develop abalone sanctuary project
- Research and develop methods to combat hatchery disease outbreaks

Long-term priorities
- Understand genetic contributions of individuals during hatchery process
- Select unique characteristics for Alaskan oysters
- Identify and select strains of shellfish resistant to ocean acidification

**Enhancement**

King crab enhancement feasibility research

Since 2006, the Alaska King Crab Research, Rehabilitation and Biology (AKCRRAB, https://seagrant.uaf.edu/research/projects/kingcrab/general/) program has assessed the feasibility of enhancing king crab in Alaska. The goal of the program is to add to the scientific understanding of crab life history and ecology, as well as the eventual rehabilitation of depressed king crab stocks in Alaska. The objectives of the program have been to develop scientifically sound strategies for hatching, rearing and outplanting king crab in Alaska, in order to help restore red king crab populations in the Kodiak region and blue king crab populations in the Pribilof Islands region to self-sustainability. To date, the methods of hatchery rearing of larval and juvenile king crab from wild-caught broodstock have been improved to the point where large-scale production is feasible. These hatchery studies have recently been complemented with parallel studies essential to understanding optimal release strategies, appropriate habitat, and potential impact on existing ecosystems.

Near-term priorities
- Outstocking methodology
- Increasing survival at initial outstocking
- Identification of natural genetic structure to help define commercial scale broodstock acquisition

Intermediate-term priorities
- Economic feasibility assessments
- Stakeholder identification
- Technology transfer (hatchery and outstocking)
- Permitting and management development with ADF&G

Long-term priorities
- Sustained broodstock acquisition
- Juvenile outstocking and monitoring
- Develop economic sustainability

**Research on macroalgae mariculture in Alaska**

**Kelp research**

***Macrocystis.*** In the late 1980's and early 1990's a giant kelp mariculture feasibility project was funded by the Japan Overseas Fisheries Cooperation Foundation (OFCF), the state of Alaska, and the National Coastal Resources Research and Development Institute (NCRI). The objective was to grow Macrocystis in culture for potential use in the herring roe-on-kelp fishery, which was mainly in Prince William Sound at that time. The research was carried out by UAS in Juneau and Sitka with the cooperation of Sheldon Jackson College. Outplanting occurred in Whiting Harbor on longlines and on several dropper type lines at various times of the year and at varying depths. Growth was monitored and oceanographic data collected throughout the year. Outplants grew well until the late summer, when most of the fronds died. Subsequent research pointed to the lack of nutrients in the water during the late summer that was limiting for growth. One successful outplanting in PWS was made before the Exxon Valdez oil spill terminated this project. The results of this research have been published. ((Stekoll 1989, 1999; Stekoll and Else 1990,1992a, 1992b,)

***Saccharina*** and other kelps. In 2015 an applied research project on the mariculture of kelps was initiated at UAS with funding from Premium Oceanic (PO), a private, for profit, company. Several species of kelps (Saccharina, Nereocystis, Alaria) were cultured in the lab, mostly seeded on string wrapped around PVC pipes. Outplantings near Juneau were done monthly starting in October 2015 through May 2016 and again in October through December of 2016. Some additional outplantings were done in Sitka. Growth was monitored and oceanographic data collected throughout the year. Preliminary results indicate that fall outplantings are best. Plants grow well through the winter and can be harvested in the spring. PO (operating as Blue Evolution) is performing research on potential products made from the kelps.

**Ongoing Kelp Research**

UAS has recently received a 2-year grant from Alaska Sea Grant to investigate a few aspects of Saccharina culture to determine optimal outplanting times, whether "cold banking" of gametophytes and/or baby sporophytes is possible, if strain selection is feasible and the life cycle timing in the natural populations.

ADF&G Gene Conservation Laboratory is currently working on a grant to do some initial population genetics of kelp species in Alaska.

**Other Macroalgae**

***Pyropia (nori).*** UAS began research in 1993 on the mariculture of several species of Porphyra (now Pyropia) as a feasibility study to determine whether one or more species could support a viable mariculture enterprise. Several species of Pyropia were collected from around southeastern Alaska and brought to the lab in Juneau. Conchocelis cultures were successfully created in both oyster shell and as free growing conchocelis. Several combinations of photoperiod and temperatures were tested in order to initiate conchospore release. Only one species, P. torta, gave consistent conchospore release under defined environmental conditions. Outplantings along the shore in Juneau did not fare well. But excellent growth of the blades occurred in the lab. More work on this needs to be done before any commercial operation can begin in Alaska. (Publications on Pyropia: Stekoll et al. 1999; Conitz et al. 2001, 2013;Lin and Stekoll 2007, 2011; Lin et al. 2008; Lindstrom et al. 2008)
(Publications are listed in Appendix IV.)

**Future Research Needs**

**Kelp**

A major issue is the population genetics of the kelps in Alaska. Since the Alaska constitution requires management of natural resources in a sustainable manner, ADF&G is conservative about where to collect seedstock and how many parent plants must be used for each outplanting. There is also a question as to

whether strain selection would be detrimental to the natural populations. But strain selection may be critical for the success of a commercial macroalgae enterprise. In addition, research on the culture of other kelp species such as Alaria, Eualaria and Nereocystis may be needed for the expansion of this industry.

The US Department of Energy under their Advanced Research Projects Agency-Energy (ARPA-E) program is currently promoting research into large scale cultivation of macroalgae for potential biofuel generation.

**Other Macroalgae**

More research is needed on the mariculture of nori (*Pyropia*) and red ribbon (*Palmaria*), both of which have good potential as high protein food sources. *Pyropia abbottiae* and *P. torta* have the best potential for commercial application. But research on conchospore stimulation and release needs to be done. *Palmaria* can be grown by fragmentation reproduction in tank culture, but research on strain selection and elimination of contaminating algae should occur.

Near-term priorities

- Population genetics of sugar kelp and *Alaria*
- Product and market research for kelp products
- Mapping of natural kelp beds for parent plant seedstock
- Creating a Mariculture Research Center

Intermediate-term priorities

- Population genetics of commercially important macroalgaes, including giant kelp, bull kelp, dragon kelp (*Eualaria*), red ribbon (*Palmaria*), and nori (*Pyropia*).
- Site characteristics important for outplanting kelps and maps indicating possible outplant sites.
- Mariculture of other species such as bull kelp, dragon kelp, and triple-rib kelp (*Cymathere*)

Long-term priorities

- Mariculture of nori and red ribbon
- Product and market research for all macroalgae products
- Continuing research on macroalgae to meet industry needs

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**Attachment I. List of priorities from ASGA 2011 meeting**

Shellfish – Mariculture: Priorities – October 26, 2011

**Topic 1. Secure seed supply, of existing seed types, oyster and geoduck.**

- 1.1 Improve quantity of in-state production of oyster and geoduck seed
- 1.2 Improved quality of the seed available to farmers in Alaska
- 1.3 Secure Alaska broodstock
- 1.4 Selective breeding of Pacific oysters, regionally specific to different areas of Alaska
- 1.5 Diversification of species, develop sources of seed for native shellfish species
- 1.6 Establish hatchery, nursery and grow-out techniques for rearing shellfish species with current or emerging potential for private, public and tribal shellfish aquaculture,enhancement, restoration and mitigation.

**Topic 2. Cooperative studies/ research/ monitoring**

- 2.1 Cooperate with the Pacific Shellfish Institute and other research agencies to develop a pacific oyster breeding program and other genetic research
- 2.2 Develop programs to assist in identification of techniques for new species production

**Topic 3. Increase shellfish production**

- 3.1 Assist existing farmers to increase the production from existing farms.
- 3.2 Assist in developing infrastructure to attract new farmers, including, lease site, seed supply, financing and education and training.
- 3.3 Assist new farms in a region to work together, ie. Processing, shipping

**Topic 4. Shellfish education, training and outreach**

- 4.1 Establish training, education and outreach programs for new and existing farmers
- 4.2 Implement outreach programs to attract new farmers
- 4.3 Create education and outreach information for the public, outside the mariculture sphere
- 4.4 Create education programs and cooperative programs for public schools, (K-12).

**Topic 5. Shellfish disease and pathology management**

- 5.1 Collaborate with regional, state and federal entities to research and understand the impact of ocean acidification on shellfish spat
- 5.2 Create a monitoring program for use by farmers to supply timely information and data regarding ocean conditions.

**Topic 6. Shellfish ecology / site selection**

- 6.1 Identify five potential areas that can become economically viable clusters for shellfish farms in southeast Alaska.

6.2 Identify the impacts and benefits of creating clusters of shellfish farms to the farmers, environment, area economy and local communities.
6.3 Create and provide informational and educational materials to use in presentations and discussions with all users of the potential cluster areas.
6.4 Quantitatively document environmental and economic impact and contribution of shellfish aquaculture.

**Topic 7. Enhancement and restoration of native shellfish stocks**

7.1 Establish a research program for enhancement of sea cucumbers, geoducks, abalone and sea urchins.
7.2 Develop a regulatory structure to encourage and provide enhancement activities for native shellfish stocks
7.3 Develop a plan to enhance subsistence clam beaches
7.4 Research the opportunity to culture Kelp (sugar laminaria, giant kelp, bull kelp, porphyra, palmaria) for economic viable business.
7.5 Develop the opportunity for polyculture activities on various shellfish farms
7.6 Support the work and research by other concerned stakeholders working on the variety issues surrounding the growth of the sea otter population and the resulting impacts on the food supplies
7.7 Identify enhancement needs and develop the criteria to determine feasibility for successful enhancement programs.

**Topic 8. Invasive species management**

8.1 Develop enhanced management techniques for invasive non-native tunicates
8.2 Develop monitoring programs and management techniques for invasive non-native European green crab
8.3 Establish monitoring programs for identification of northern anchovies in southeast Alaska waters.

**Topic 9. Human health and shellfish**

9.1 Improve understanding of the dynamics of Paralytic Shellfish Poisoning (PSP) accumulation in geoducks and other bivalve shellfish species,
9.2 Research the factors affecting environmental conditions and the occurrence of Vibrio bacteria in bivalves
9.3 Improve understanding and dynamics of domoic acid accumulation in all bivalve shellfish species.
9.4 Support research directed at developing effective methodologies to control the impacts of marine biotoxins, bacteria, viruses, and heavy metals in live shellfish.

**Topic 10. Water quality**

10.1 Develop a strategy to respond to water quality issues in shellfish growing areas.

**Topic 11. New methods and new products**

11.1 Investigate methods of processing shellfish to reduce costs, increase quality and improve productivity
11.2 Develop a library of best practices for processing shellfish
11.3 Produce data and information regarding beach culture for growing oysters in southeast Alaska.
11.4 Investigate and report on shellfish farming systems that reduce mortality in shellfish and reduce cost of labor in all aspects of the farm structure
11.5 Investigate farm methods and provide information that improves the ergonomics that will reduce the risk of physical injuries.

**Topic 12. Marketing strategies**

12.1 Research and report to the shellfish industry the opportunity, means and methods for self marketing farm shellfish products.
12.2 Research and report to the shellfish industry the opportunity and methods to develop a web based marketing program.
12.3 Research and report the benefits of cooperative activities in marketing shellfish products.

**Topic 13. Policy and regulations**

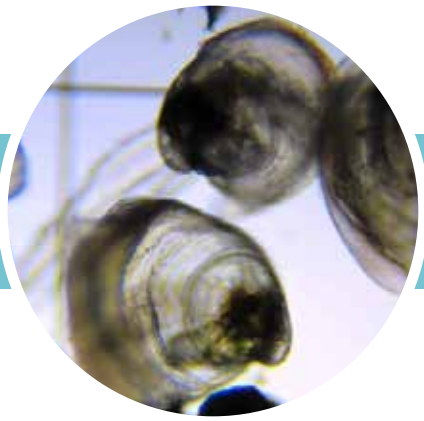
13.1 Develop strategy to foster a positive regulatory environment with state and federal authorities which supports environmentally sound shellfish culture.
13.2 Develop a strategy to approach the Alaska Board of Fish and other state agencies regarding the importation of oyster species other than C. gigas.
13.3 Promote the shellfish industries Environmental Policy
13.4 Encourage more effective risk assessment and risk management by agency personnel which

recognizes the positive beneficial effects of shellfish aquaculture for the environment.

**Attachment II. ASGA Meeting 2016 Anchorage, Alaska Shellfish Culture Bottlenecks Workshop**
Dec. 9, 2016 Carter Newell and Bobbi Hudson facilitators

*1. Review of previous documents in 2006 and 2011 about industry bottlenecks:*
**Seed security** for shellfish farms – still an issue, but improved with OA hatchery
**Financing Programs** – USDA Farm Service Agency best bet, loans with payoff 7-10 years, PCSGA and ESGA also have resources
**Ongoing Issues** – with shellfish closures and Harmful Algal Blooms (HAB's), PSP
**Regulations** - Mariculture Task Force – a regulatory review is underway to streamline regulations. There is an interest in smaller, less onerous permits for pilot scale projects
**Enhancement** – might be good for the state, but growers not very interested. Might also provide income diversification for hatcheries, helping the seed security issue (above).
**Best practices** – there is a need to review and document this in Alaska, and make it available to growers (on the Web?). Technology transfer is still a major priority, and a dozen growers are participating in the Sea Grant project Alaskan Mariculture Diversification, Innovation, and Technology Transfer (2015-2017), trying alternate oyster gear and participating in sugar kelp and winged kelp grow-out trials.
**Information sharing** – is there a platform for this? best practices, development of macroalgae industry, red tide and water quality information, efficiencies in shipping, wholesale discounts? Is the ASGA website or Alaska Sea Grant good for this?
**Remote sites** and cost issues a big concern still – how to reduce costs?
**Farm tours** are valuable but could be better defined, including the intentions of the groups and the outcomes desired.
**Training programs** – University of Alaska SE Fisheries Technology program may be the best platform for vocational mariculture training – and have some experience with shellfish modules
**Kelp** – lots of interest and participation – need help with marketing and sales. Unclear if ASGA is going to take the lead on the new industry or if it should start a new group.
University of Alaska Fairbanks and Juneau – Sea Grant is based in Fairbanks. Mike Stekoll in Juneau – great resource for developing macroalgae industry. At both universities - large expertise in marine sciences to tap and could be helpful for new species development (macroalgae, scallops, urchins, crabs, abalone, cucumbers?), site oceanography, HAB's, disease monitoring, and training the next generation of entrepreneurs. Need new faculty in invertebrate mariculture and mariculture engineering.

*2. We then did a thumbs up/thumbs down of the OceansAlaska 2011 research bottlenecks update:*
**Seed supply YES**
**Site knowledge** (oceanography, growing conditions, etc.) **YES**
**Production technology** (cost, efficiency, suitability to Alaska) **YES**
**Training** – for new and existing growers, including business planning **YES**
**Disease** – monitoring, control, preventative measures **YES**
**Human health and marketability** – vibrio, fecal coliforms, PSP, DSP, ASP **YES**
**Enhancement** – not a big priority for growers
**Invasive species** – we have to deal with it
There was a discussion of the fact that many of the bottlenecks identified in 2006 and 2011 are still the same in 2016 in Alaska, and there is the need for an industry-led group to address some of these in order to accelerate industry growth. The Alaskan Mariculture Initiative may be an opportunity to address some of the issues and apply some resources to solving them.
Progress is being made to reduce grow-out times of oysters from 5 years to 3 years through a combination of flupsy, surface trays, and suspended stacked trays in longlines or rafts. Growers are increasing inventories and receiving premium prices for their high quality oysters. We expect a steady growth of oyster sales in the coming years, with other species (mussels, macroalgae, geoducks) coming online.



# Alaska Mariculture Development Plan

*State of Alaska*

*March 23, 2018*

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MARICULTURE