OceansAlaska Marine Science Center

The OceansAlaska Marine Science Center, located on 28 acres granted by the State of Alaska and Ketchikan Gateway Borough in 2006, is a viable and exciting economic development project in Southeast Alaska. The Center's mission is to contribute significant and sustainable long term economic growth to coastal Alaskan communities by supporting Alaska's shellfish industry. The Center, situated on pristine George Inlet outside of Ketchikan, has three marine science functions – research, exhibition and education .

Site drawing; artist rendering.

The Center's exhibition facility taps into the Alaska visitor industry and provides immediate revenues. An in-depth feasibility study shows the exhibition program will provide revenue to operate the facility. The Center's marine science educational program is suited to all levels of Alaska's educational system. However, the Center's significant long term impact comes from its shellfish research and development division. Research and development will facilitate the emergence of a globally competitive Alaska shellfish industry and provide a sustainable economic engine for Alaska's coastal communities.

This report shows how research, development, demonstration and training programs at the OceansAlaska Marine Science Center will propel growth of Alaska's coastal shellfish industry – oysters, clams, geoduck, scallop, abalone, kelp, macrophytes and other aquatic farm products as defined by Alaska Statute[1] – enabling Alaska's industry to expand with the growing global demand for shellfish. Included in this report are:

- *The potential for growth in Alaska's shellfish industry and its ability to supply an expanding global shellfish market*
- *The role of Research and Development in removing obstacles to Alaska shellfish industry growth*
- *A business plan for the OceansAlaska Marine Science Center*

[1]Alaska Statute 16.40.199 defines which species are included and excluded from aquatic farming in the State of Alaska and appears as Appendix A. The Center would limit its programs to those aquatic species covered by AS 16.40.199.

OceansAlaska Marine Science Center Board

Gary Freitag – President: Scientist and fisheries biologist, Freitag is employed as research and evaluation manager for the Southern Southeast Regional Aquaculture Association. He is owner and chief consultant for Oceanographic Services of Southeast Alaska, a firm that specializes in environmental oceanographic, fishery and marine mammal site surveys. Freitag is the author of numerous patents and publications for Imperial Chemical Incorporated of America. He is also an aviator. Freitag helped establish the Tongass Coast Aquarium board in 1992 and serves as its president.

OceansAlaska Marine Science Center Board Meeting

Tena Williams – Treasurer: Co-publisher of the Ketchikan Daily News, Williams was born, raised and has worked in Southeast Alaska most of her life. She has served as president of the Greater Ketchikan Chamber of Commerce as well as the Alaska Newspaper Association, and currently serves on the Ketchikan General Hospital Governing Board and was appointed to the Alaska Judicial Council by Gov. Frank Murkowski. She is an enthusiastic quilter. Williams helped establish the Tongass Coast Aquarium board in 1992 and serves as its treasurer.

Mayor Bob Weinstein: Mayor of Ketchikan since 1997, Weinstein is in his third term. He has a bachelor degree from the University of Massachusetts-Amherst, and a master degree from the University of Oregon. Weinstein came to Ketchikan in 1974 and worked as a teacher and superintendent with the Southeast Island School District until 1994. He was elected to the City Council in 1991. Weinstein is an active member of the Ketchikan Running Club and enjoys kayaking and reading, especially mysteries.

Len Laurance: An owner in Alaska Rainforest Sanctuary, Laurance is a key figure in the Ketchikan tourism industry. He has lived in Ketchikan more than 40 years, during which time he has worked as marketing director, consultant, and tourism and community advocate. Laurance is a former assemblyman for the Ketchikan Gateway Borough and has served on the board of directors for the Greater Ketchikan Chamber of Commerce and the Ketchikan Visitors Bureau. He helped establish the Tongass Coast Aquarium board.

Ray Troll – Vice President: Troll is a well-known Ketchikan artist and author who owns and operates Soho Coho Gallery with his wife, Michelle. He has exhibited his art of the marine environment throughout the world. Troll has written a number of books, including, *Planet Ocean: A Story of Life, the Sea and Dancing to the Fossil Record* and *Ray Troll's Shocking Fish Tales, Fish, Romance and Death in Pictures*. He helped establish the Tongass Coast Aquarium board in 1992 and serves as its vice president.

Kate Sullivan: Professor of Fisheries Technology at the University of Alaska Southeast, Ketchikan, Sullivan teaches in, and develops and coordinates, the fisheries program. She is employed as a manager and project director in fields of education, fisheries, natural resources and resource development. Sullivan is the author of several papers related to her work. She joined the Tongass Coast Aquarium board shortly after moving from Montana to Alaska in 2003.

Monica Schultz: A registered nurse with more than 19 years of clinical experience in hospitals and primary care facilities, Schultz manages a medical practice, overseeing financial aspects and compliance with all government regulations. She was a 2003 appointee to the clinical faculty at Weber State University and has lived in Alaska since 1990. She and her husband, Dr. Stacy Schulz, are enthusiastic divers.

Alan Murray: An avid scuba dive instructor and underwater photographer, Murray works as an Otolith Lab Technician and Research Assistant for the Southern Southeast Regional Aquaculture Association in Ketchikan. Murray also has been a small business owner for 27 years, most recently operating Murray Records and Tapes. He joined the Tongass Coast Aquarium board in 2003.

Jerrold Koerner: Retired Alaska Department of Fish and Game fisheries biologist, Koerner has lived in towns throughout Southeast Alaska. He has owned Jerry Appleseed Nursery and Experimental Orchard since 1993, conducting trials on more than 450 early- ripening apple varieties suitable for growing in Southeast's short season and maritime climate. Koerner has lived in Alaska for more than 30 years and has served on the Tongass Coast Aquarium board of directors since February 1996.

Tomi Marsh: Owner of the boat, "Savage," Marsh has been involved in the commercial fishing industry for 24 years. She has fished for crab from the Bering Sea of Alaska to the coast of Washington state, and participated in a variety of other Alaskans fisheries. In conjunction with the Alaska Seafood Marketing Institute, she has been active in fisheries marketing promotion. Marsh joined the Tongass Coast Aquarium board in 2006.

John Sund: As Project Manager Sund brings decades of varied experience to OceansAlaska. Most recently Sund was VP of Operations for NorQuest Seafoods, one of Alaska's major seafood processors. Sund also served three terms in the Alaska Legislature, was President of Waterfall Resort one of Alaska's premier fishing resorts and was involved in several roles crafting legislation for Alaska's non-profit hatchery system. He has planned, supervised construction and completed startups on major capital facilities in many locations in coastal Alaska.

Acknowledgements

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A team of professionals has been formed to formulate the design and budgets.

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There can be little doubt that Alaska has more potential undeveloped sites for shellfish aquaculture than the rest of the United States combined. The protected and undeveloped shoreline of Alaska's Panhandle alone provides the opportunity for siting literally hundreds of shellfish farms. Recognizing this potential, the state began leasing sites in 1988. Alaska now funds an in-state hatchery and certifies hatcheries from Washington and Oregon to allow import of seed for enhancement. Alaska also funds several Floating Upwelling Nursery Systems (FLUPSY) for oysters. Currently, the combined wild and farmed harvest of shellfish is over $7 million a year. With a sustained and coordinated research and development program among industry, community and government stakeholders this number could easily grow many times more, providing Alaska's coastal communities long-term economic growth.

There is a distinct pattern in aquaculture success stories around the world. Production of a species languishes for years until a sustained, government funded research and development program is focused on removing the constraints to its development. Removal of constraints – over a 10-20 year period – causes a snowball effect and eventually, when enough constraints are removed the species gains developmental momentum and rapid growth of the industry results.

In New Zealand, which like Alaska has a small population, strong fisheries, unpolluted coastline, large distances to primary markets and dependence on export markets, the greenlip mussel has been the focus of an intense, government funded research and development program. As a result, since 1988 the greenlip mussel has grown from a harvest value of $15 million a year to $96 million in 2002 with a combination of wild and cultured harvests. The industry now provides 1500 jobs, with revenue of $60,000 generated per job.

The Keys to Industry Success:

- *Publicly funded research and development to overcome barriers to development*
- *Common vision and goals of industry and government*
- *Industry cooperation and collaboration to tackle barriers*
- *Use of wild harvest, enhanced culture and intensive culture methods*
- *Product form innovation to overcome transportation disadvantages*
- *Effective generic marketing to penetrate new markets*
- *Value added products to overcome cost and market barriers*

Around the world, governments with shellfish fisheries understand that the potential for shellfish aquaculture and enhancement does not translate automatically to industry growth, more is needed. The strategies outlined above are being employed to grow shellfish industries and take advantage of the ever-growing market for food from the oceans.

Aquaculture is Expanding to Meet Global Demand

Worldwide production is shifting from traditional wild capture fisheries for seafood products to the commercial cultivation of farmed species through aquaculture. To meet the increasing demand for seafood, aquaculture has

expanded very rapidly and is now the fastest growing food-producing industry in the world. The U.N. estimates that by 2030 over half of the fish consumed by the world's people will be produced by aquaculture, with production tripling by 2050. Filter-feeding mollusks such as oysters, mussels, scallops, and clams provide 86% of the total aquaculture production. The U.S. is an important market for Alaska shellfish and will increase from 11 to 14.3 billion pounds by 2020, as the overall demand for seafood grows steadily. The challenge to Alaska is to position itself to participate in this market growth with a competitive industry and products.

What is Alaska's Potential?

No detailed scientific and economic study has been conducted to quantify the exact potential of shellfish aquaculture in Alaska. However, a federal Canadian study concluded that the current shellfish industry production of British Columbia of $23 million Canadian dollars could expand to $760 million CDN. Alaska's potential is greater in the long-term due to its greater coast line and marine resources. In New Zealand, the greenlip mussel industry grew 500% after industry constraints were removed. The Japanese scallop industry dawdled for four decades and suddenly witnessed a two decade growth spurt from 10,000 tons to 200,000 tons and a value of $400 million after technology and other culture and enhancement roadblocks were overcome.

We conservatively estimate Alaska's shellfish industry to grow from $7 million to $50 million after a sustained and coordinated research and development program is implemented to remove industry constraints.

What are Constraints to Alaska's Shellfish Industry?

A recent report by the University of Alaska summed up Alaska's shellfish aquaculture as a cottage industry with potential for hundreds of millions of dollars. The report summarized the leading constraints:

- *A restrictive regulatory climate*
- *The high cost of doing business in rural areas of Alaska*
- *A lack of investment capital, and*
- *Limited government support in research and development and training*

Can They Be Overcome?

Alaska's experience in reviving the salmon harvests illustrates the potential, and role of, research and development in removing constraints. In the early 1970's a government and industry task force chartered by Governor Hammond constructed a detailed plan to rebuild Alaska's salmon industry with the theme "One Hundred Million Missing Salmon." Goals, constraints and strategies were defined. Over the next two decades salmon hatcheries and enhancement played a large part in this very successful program along with sound biological management and conservation. Research, development and technology transfer provided the foundation for all of these programs. The hundred million missing salmon goal was exceeded. Today commercial, sports, subsistence and visitors in Alaska's coastal communities enjoy the benefits of Alaska's prolific salmon harvests.

Bringing Alaska's Shellfish Industry to the Takeoff Point…

The OceansAlaska Marine Science Center

Recognizing the need for research and development of aquatic farming in Alaska, the State of Alaska and Ketchikan Gateway Borough granted 28 acres for the OceansAlaska Marine Science Center in 2006. The Center is a catalyst for Alaska's shellfish industry to gain takeoff speed and achieve its potential. The Center acts as a forum to define and update research and development priorities for the industry. It provides a focal point for industry, government and community stakeholders to systematically address the entire host of constraints and barriers. The Center's focus on research, development, demonstration and training projects will assist the industry in overcoming barriers to growth.

VISION

The OceansAlaska Marine Science Center will facilitate the emergence of a globally competitive Alaska shellfish industry that will serve as a sustainable economic engine for healthy and vibrant coastal communities. The Center will house three integrated marine science functions – research, exhibition and education. The Center will become a respected research, development, demonstration and training organization both nationally and internationally.

MISSION

The OceansAlaska Marine Science Center will focus on research, development, demonstration and training projects that are catalysts for the shellfish industry throughout Alaska. The Center will:

- *Be directed by industry, community and government stakeholders to maintain focus on industry priorities*
- *Provide a forum and methodology to establish industry research, development and training priorities*
- *Focus on removing industry growth constraints*
- *Provide a sound scientific basis for the sustainable development of the Alaska shellfish industry*
- *Communicate results of relevant research projects to industry*
- *Provide effective demonstration and training programs for the shellfish culture and enhancement workforce*
- *Transfer globally sourced technology to the shellfish culture and enhancement industry*

The Center's Research, Development and Training Program

Facilities. Research and development projects and facilities will be fully integrated in the design and operations of the entire facility and available for visitors to view. Wet laboratory, dry laboratory, research areas and offices will be integrated on three floors of visitor marine exhibits with a total of 4,700 square feet reserved for these specific functions.

Other research and training facilities will be located on docks and floats. The George Inlet site is ideal for utilizing pristine

and uncontaminated salt water at various depths as the shoreline drops quickly and has good tidal flows. Facilities will include a floating upweller system (FLUPSY), growing floats and operations warehouse. The FLUPSY will allow nursery growout of shellfish seed. Growing floats will allow cages, lanterns and other growing mediums for shellfish. The site and facilities will be capable of supporting intertidal, subtidal and suspended aquaculture and research projects.

The FLUPSY: Floating upweller system

The warehouse will provide a covered facility for sorting, inspection, cleaning and the many other culture activities that will accompany oyster, clam, geoduck, scallop, abalone, kelp, macrophytes and other aquatic farm products culture techniques. These facilities will provide the ability to test new and varied technologies for culturing equipment and techniques to develop best practices suited to Alaska conditions.

Management. The OceansAlaska Marine Science Center is organized as a 501(c) 3 non-profit corporation. The Center is governed by a ten-member board representing a broad range of community interests and expertise. The R&D Program will be led by a Board composed of eleven members. Seven members of the Board will be chosen from the shellfish industry and four members from government agencies involved in fisheries. An Executive Director will manage the center with a senior research scientist in charge of research operations, and an experienced aquaculturist will run the training programs.

Setting Research Priorities. Initial research priorities for the R&D division will be critical. The Center will use priority-setting processes that have been successfully established by research and development organizations and industries in and outside of Alaska. The initial process will take one year and be completed before the commencement of construction of Center facilities. This will allow the center to incorporate any new research needs in its design, equipment and staffing.

Research Partnerships. The Center will accomplish many of its goals through collaborative work with other research and educational institutions. The starting point for these relationships will be to identify opportunities and define working relationships by formalized "Memorandum of Understandings."

Budget. The integration of the research, exhibition and education programs at the Center will spread overhead and operational costs amongst the three programs. A separate feasibility study has documented that $ 2.6 million annual revenues from the visitor industry will be available to fund the base operations of the facilities.

The base budget for full scale operations of the R&D program will be $460,000 annually. Additional amounts will fluctuate, based on specific funding and partnerships on research, development and demonstration projects. A stand alone R&D facility would require a budget greatly in excess of $ 460,000.

Funding. Research and development funding will come from a broad array of sources – fees for services, private foundation support, endowments, industry funds, federal and state government research grants and collaborative research projects. Research, development, training and the demonstration farm programs will have different strategies and sources of funding. Funding will be diversified and not overly dependent on any one source.

Opportunity for Alaska's Shellfish Industry to Grow

Potential of Shellfish Culture and Enhancement

While there have been no scientific studies or surveys quantifying Alaska's exact potential for aquatic farming, there can be little doubt that Alaska has more potential undeveloped sites for shellfish aquaculture than the rest of the U.S. combined. The protected and undeveloped shoreline of Alaska's Panhandle alone provides the opportunity for siting literally hundreds of shellfish farms. Most of Alaska's long coastline is pristine and sparsely populated, and state law and regulation provide for aquatic farming in most areas. While shellfish farmers have struggled mightily with state agencies for many years, the reality is that because there are fewer competing interests, less pollutants and less regulatory hurdles, it is far easier to site a new shellfish farm in Alaska than in any other region in North America[2].

Oyster worker in Metlakatla

Most of Alaska waters are rich, and oyster farmers have shown that shellfish can grow well in areas previously thought too far north to support efficient shellfish growth. In reality, Alaska oysters grow nearly as fast in Prince William Sound, the northernmost farming area in Alaska, as they do in most areas of Washington, British Columbia and Oregon. Oyster connoisseurs, such as David Rockefeller, have compared Alaska oysters to the best they have sampled anywhere in the world .

Another advantage Alaska has is the powerful mystique of pure waters and pristine wilderness providing the best seafood in the world. These positive images, and the frontline work of the Alaska Seafood Marketing Institute, give Alaska seafood a head start in the marketplace.

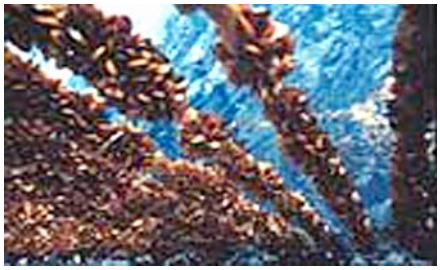
Not only does the "image" of pure waters serve Alaska seafood, the "reality" of our pristine waters does as well. Water quality continues to be degraded around the world through pollution, erosion and loss of intertidal and estuarine areas. In Washington State alone 22% of the shellfish areas are off limits to harvest for human consumption. Disease has stricken many areas of seafood culture due to the unregulated and unscientific expansion of aquaculture in poorer countries. At the same time as this degradation is occurring, food safety and security concerns are growing in consumer nations with a higher standard of living.

Aquaculture Success Stories: The Pattern

There is a distinct pattern in aquaculture success stories. In most cases, production of a specific species languishes at a very modest level for many years, even decades. At some point – as sustained research and development are focused on a species – the species reaches a takeoff point. More rapid growth ensues over a 10 to 20-year time period and the species becomes a major industry.

[2]Aquaculture is shrinking in places such as Puget Sound where homeowners and recreations users compete for waterfront and oppose commercial development.

The takeoff point for an individual aquaculture species is related to the sustained effort over time to remove the constraints that restrict industry growth. Removal of constraints causes a snowball effect and eventually, when enough constraints are removed, the species gains developmental momentum and rapid growth of the industry results. A good example of this process is New Zealand's greenlip mussel.



New Zealand Green-lipped Mussel, a $100 million industry

Greenlip mussels existed for many decades as a small wild fishery in New Zealand. Early culture efforts did not take hold until the government supported a sustained research and development effort. This effort catapulted New Zealand's greenlip mussel from a $12 million industry to nearly $100 million industry in 20 years.

By contrast, New Zealand's spiny lobsters, which are also naturally prolific and have a high market value, have not become a big industry. This is because there has been no sustained effort to remove the constraints to spiny lobster culturing.

Projecting Growth of Alaska Aquaculture

Several aquaculture histories – aside from greenlip mussels – are helpful to project Alaska's shellfish potential:

Japan harvests 500,000 tons annually of Scallops

- **Japanese Scallop Industry.** *Japan's scallop industry existed as a wild fishery and went into a period of declining wild harvests. Early aquaculture, to increase the harvests, stagnated for four decades. Within 35 years, from the mid 1960's, when the Japanese began a sustained effort to promote scallop industry, to the end of the century, the industry grew from 10,000 tons to over 500,000 tons of sustained annual harvest .*

- **Alaska Salmon Hatchery Program.** *Alaska started a salmon hatchery program with both state and nonprofit run hatcheries in the mid 1970's to revive the salmon harvests. Hatcheries prior to this time had not been very successful in Alaska and their contribution to the salmon fisheries was negligible. In the early 1970's a government and industry task force chartered by Governor Hammond constructed a detailed plan to rebuild Alaska's salmon industry with the theme "One Hundred Million Missing Salmon." Goals, constraints and strategies were defined. Over the next two decades salmon hatcheries and enhancement played a large part in this very successful program along with sound biological management and conservation. Research, development and technology transfer were foundational to all of these programs. The hundred million missing salmon goal was exceeded. Fifteen years later, Alaska salmon hatcheries produced 50 million returning salmon and continue to be a growing success story today despite the economic challenge of farmed Atlantic salmon. Alaska's experience in reviving the salmon harvests illustrates the potential and role of research and development. Today commercial, sports, subsistence and visitors in Alaska's coastal communities enjoy the benefits of Alaska's prolific salmon harvests.*

The Hidden Falls hatchery and the salmon seine fleet at work.

- **Atlantic and Pacific Salmon.** *Efforts to grow Atlantic and Pacific salmon in cages started in the 1960's but only produced a global industry of 5,000 tons by 1980. Ten years later, by 1990, Atlantic salmon production exploded to 240,000 tons in a dozen countries on several continents. In addition, 60,000 tons of other salmon species were being farmed.*

The large potential of aquaculture is evident in these success stories, where production has rapidly accelerated in 10 to 20 years. Predicting the date when the takeoff of a "new industry" will occur, however, is problematical. In addition, success stories must be balanced against other aquaculture species that never achieved takeoff speed. For example, salmon aquaculture began with king and silver salmon in British Columbia; however silver salmon aquaculture never succeeded there. Atlantic salmon turned out to be the successful species for British Columbia. In a strange twist, silver salmon aquaculture did become successful in Chile.

No detailed scientific and economic study has been conducted to predict the exact potential of shellfish aquaculture in Alaska. The Canadian government, though, has conducted a study to determine the potential of the British Columbia shellfish industry. Their forecast was built on specific identified feasible shellfish species. The study concluded that British Columbia's current industry production of $23 million Canadian dollars could expand to $760 million Canadian dollars. This forecast is similar to the success stories above that demonstrate growth patterns of 20 to 40 times.

Alaska's coast line and marine resources are significantly larger than British Columbia. However, we have made several conservative assumptions in projecting shellfish growth in Alaska:

- Alaska's high costs and distance from market will allow lower cost and more favorably located production areas to fill market demand first
- Research and development to resolve barriers to success for Alaskan shellfish species will take 5-10 years for each species
- Alaska will continue to be conservative in protecting its abundant wild fisheries

Taking these factors into consideration, we predict that within 20 years of the establishment of a systematic research and development program to remove industry constraints Alaska's shellfish production will expand sevenfold, from a $7.37 million to a $50.52 million industry. Table 1 shows our projection in five-year-increments. This is a modest prediction – less than 10 times the current production – compared to the experience of other fisheries, but it is very significant in terms of the impact it will have on Alaska's coastal communities and their well-being.

Table 1. Alaska Shellfish Potential

	Current*	5 Year	10 Year	15 Year	20 Year
	Exvessel / Exfarm Value	Exvessel / Exfarm Value	Exvessel / Exfarm Value	Exvessel / Exfarm Value	Exvessel / Exfarm Value
Wild Harvest	$6,752,600	$10,562,500	$14,652,500	$18,600,000	$19,100,000
Farm Harvest	$ 624,549	$ 4,168,000	$10,870,000	$22,590,000	$31,420,000
Total Shellfish	**$7,377,149**	**$14,730,500**	**$25,522,500**	**$41,190,000**	**$50,520,000**

*Current year is defined as the year a systematic research and development plan and funding are put in place.
Source: Current data is from Alaska Department of Fish and Game, Division of Commercial Fisheries, 2004.

Figure 1. Southeast Alaska Aquatic Farm Sites.

Alaska Department of Fish and Game, Division of Commercial Fisheries, Annual Mariculture Report. 2003.

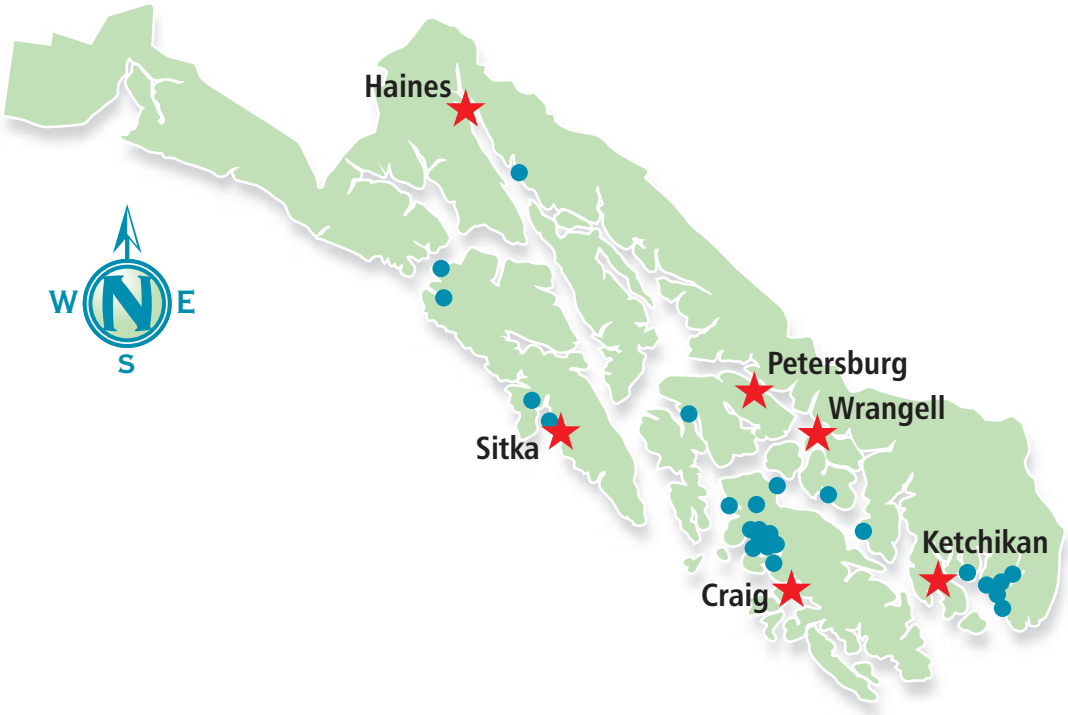
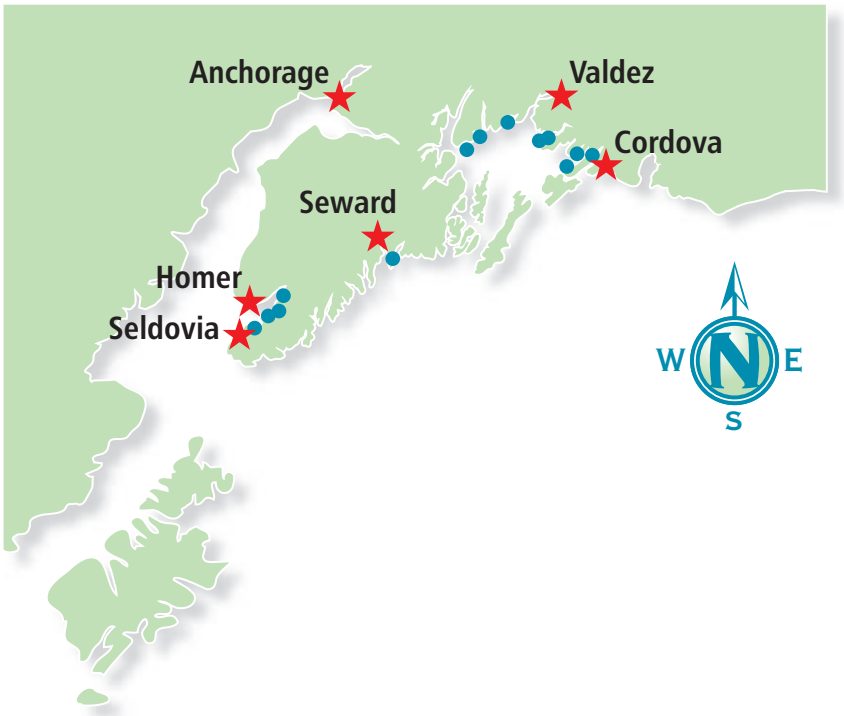


Figure 2. Southcentral Alaska Aquatic Farm Sites.

Alaska Department of Fish and Game, Division of Commercial Fisheries, Annual Mariculture Report. 2003.



Aquaculture is Expanding to Meet Global Demand

"The Aquaculture Industry holds great promise because demand for seafood is rising, the total global wild fisheries catch has leveled out since the mid-1990's as fish stocks have become depleted. In the U.S. 30 percent of the known wild fishery stocks are already overfished or in the process of being depleted through overfishing. Aquaculture represents another source of seafood to boost the fish supply."

-- America's Living Oceans: Charting a Course for Sea Change
Pew Oceans Commission report, May 2003

Worldwide production is shifting from traditional wild capture fisheries for seafood products, to the commercial cultivation of farmed species through aquaculture. To meet the ever-increasing demand for seafood, aquaculture has expanded very rapidly and is now the fastest growing food-producing industry in the world. The challenge to Alaska is to position itself to participate in this market growth with a competitive industry and products.

From 1984 to 2002 aquaculture has more than doubled, growing from 12 to 30 percent of the world's food supply of aquatic products. Aquaculture has grown at an average rate of 8.9 percent per year since 1970, compared with only 1.2 percent for capture fisheries and 2.8 percent for terrestrial farmed meat-production systems over the same period, according to figures collected by the United Nations Food and Agriculture Organization in its *State of the World Fisheries and Aquaculture* reports (SOFIA) for 2004 and 2005. Table 2 shows that between 1998 and 2003 aquaculture grew from 30.6 million tons to 41.9 million tons. Aquaculture's 11.3 million ton growth made up for most of the 13.9 million tons of total growth in world fisheries from 1998 to 2003, according to SOFIA reports.

Table 2. World Fisheries Production and Utilization in Million Tons

	1998	1999	2000	2001	2002	2003
Total Capture	87.7	93.8	95.5	92.9	93.2	90.3
Total Aquaculture	30.6	33.4	35.5	37.8	39.8	41.9
Total world fisheries	**118.3**	**127.2**	**131.0**	**130.7**	**133.0**	**132.2**

Source: U.N. Food and Agriculture Organization (FAO)

By 2050, SOFIA estimates aquaculture production to reach 105 million metric tons, more than double the 41.9 million metric tons produced in 2003.

Of particular note to Alaskans is the growth in filter-feeding mollusks such as oysters, mussels, scallops, and cockles. When marine plants are excluded, SOFIA figures show approximately 86% of the total finfish and shellfish aquaculture comes from filter-feeding mollusks. In 2003, this amounted to 19.4 million metric tons. The most harvested species in recent years has been the oyster, which grossed 4.7 million metric tons in 2003 .

The growth in filter-feeding mollusks to fill world protein demand is not by happenstance. Protein generated from mammals, poultry, and fish aquaculture such as salmon, shrimp and tuna, are all dependent on expensive protein feeds. Fish meal has a cost and a limited supply. Increasingly, farmers of mammals, poultry and fish are competing for the same limited supply of fish meal. Filter-feeders have the long term advantage of being at the bottom of the food chain and filtering free food from the oceans.

Global Demand Creates Greater Market Potential for Alaskan Shellfish

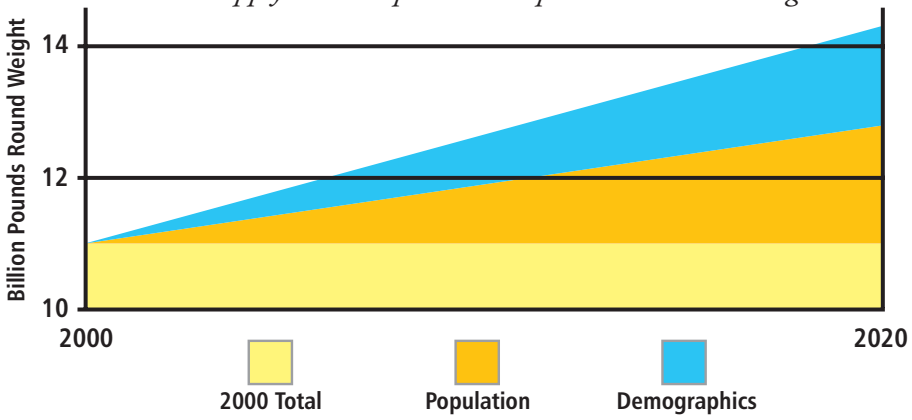
Several forces are driving this increased demand for protein from the oceans of the world. First, world population has driven demand. Second, and more importantly, economic growth, especially in large countries like China and India, is driving demand. As a country's economy grows, so does its demand for protein. In recent decades, this growing demand has increasingly been met by farmed fishery products. All of which present a growing opportunity for the Alaskan shellfish industry.

Currently, Alaskans sell most of their shellfish in the United States. The United States will remain an important market for Alaska shellfish and this market will grow – demand is expected to increase from 11 to 14.3 billion pounds by 2020 fueled primarily by population growth and increase in per capita demand based on an aging, health conscience, population[3].

Another potential market for Alaska—in particular its geoduck harvest which has great potential for expansion—is China. China is the major export market for giant geoduck clams. Although it is hard to predict the impact of China's growing demand for geoduck, in just the last few years the price of geoducks has continued to rise with the growing supply[4].

Future U.S. Seafood Demand

Population growth and changing demographics alone will require an additional 3.3 billion pounds (round wt.) by 2020. Greater supply and low prices could push demand even higher.



[3]Johnson, Howard M. Market Opportunities for Shellfish Aquaculture, Shellfish Aquaculture Conference, Anchorage, Alaska. 2004

[4]An economist with Northern Economics, Jonathon King, did market research for the State of Washington in 2004. The research showed despite the very narrow penetration of only a few major cities in China, the market has easily absorbed increased production of geoduck from aquaculture in recent years. The continued 8-10% annual growth in China's GDP bodes well for the continued expansion of the buying power of Chinese consumers.

Not only is consumption projected to grow in the United States and China, SOFIA estimated in 2000 that by 2030, over half of the fish consumed worldwide will be produced by aquaculture.

As aquaculture provides a greater and greater portion of the world's food, Alaska must position itself to take advantage of this opportunity. With sustained research and development, constraints now in place may be overcome and Alaska's shellfish industry will be poised for takeoff.

Alaska Aquaculture Species Poised for Growth

With the intent to diversify the state economy and highlight Alaska seafood in the world market, the Aquatic Farm Act of 1988 authorized the first permits for construction and operation of aquatic farms and hatcheries in Alaska. By the end of 2005, the Alaska Department of Fish and Game reported a total of 58 aquatic farmers received permits to culture Pacific oysters, blue mussels, purple hinge rock scallop, native littleneck clams, and Pacific geoduck clams. Of these, 29 reported shellfish sales with the majority coming from oysters ($565,964) and littleneck clams ($103,772)[5].

Of the species currently being farmed in Alaska, we've chosen two to highlight as poised for takeoff: Oysters and geoducks.

Oysters

With many oyster farms in three regions of Alaska, important technology hurdles overcome, more efficient broodlines increasing productivity and unfulfilled market demand, the oyster industry is poised for significant growth .

Oyster farms are creating jobs in coastal Alaska

Pacific oysters are the predominant farmed species and are an exception to Alaska's strict exotic species import restriction that requires farmers to culture only indigenous species. Since Alaskans farmed Pacific oysters before statehood, these oysters were exempted from the rule.

The reputation of Alaskan-grown oysters for quality and safety is unsurpassed and farmers are selling every oyster they can grow to niche markets. However, for the industry to grow, to attract and sustain larger lucrative markets, requires an enormous increase in production. What is needed is a coordinated planning process so that production and marketing can be synchronized.

Bringing Alaskan oysters to this takeoff point has taken a sustained research and development effort over the past 20 years. This work includes the development of the following programs:

- *Alutiiq Pride Shellfish Hatchery, funded by the Alaska legislature in 1997 with a $3.2 million appropriation, the Alutiiq Pride Shellfish Hatchery (ASPH) in Seward, Alaska, replaced a pilot hatchery. This production-size facility enables the shellfish farming industry to bring native species into mass production.*
- *Floating Upwelling Nursery System (FLUPSY), developed in 1994 and winner of the EDA award for innovation, is a system by which shellfish spat are raised in a protected nursery environment until ready for planting on farms. This innovation virtually eliminates*

Flupsy's have provided a technological boost to shellfish growers

[5]Alaska Department of Fish and Game, Division of Commercial Fisheries.

spat mortality and halves production time from four years to two years. FLUPSY provides shellfish farmers with greater returns. One oyster grower reported spat from Alaskan FLUPSY had improved quality, provided higher survival rates, lowered shipping costs, and effectively lowered total costs by 15 %.

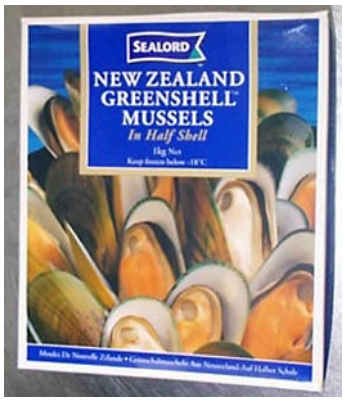
- ***Alaskan Molluscan Broodstock Program**, financed by funds from Alaska Science and Technology, provided Alaskan participation in the USDA Molluscan Broodstock Program centered in Hatfield Marine Laboratory in Newport, Oregon. The third iteration of seed production is now in progress in Prince William Sound. So far broodlines have achieved approximately a 20% increase in growth and are now used for hatchery seed production. This program has tremendous potential for Alaskan shellfish in other growing areas as well .*

The large oysters are the results of the oyster breeding program with the potential to greatly increase yields for Alaska

- ***Frozen Oyster Product Development**, is being studied by the Fisheries Industrial Technology Center (FITC) in Kodiak to develop a frozen half shell oyster product of acceptable quality for the global market. New Zealand mussel export marketing took off after they perfected their frozen half shell product technology. Their next step was to gain market acceptance. Alaska oysters are already a quality product, but are deterred from premium global market by high air freight transportation costs. Other Alaskan seafood have perfected product forms that use lower cost marine and surface transportation.*

FITC in Kodiak is studying the shelf life, taste profile and market acceptance of frozen Alaskan oysters. So far, results are promising. Alaskan oysters have demonstrated premium flavors in taste contests with other oysters. Many oyster growing regions have oysters with poor taste and texture during warm summer months. Alaska's waters are temperate year-round and alleviate this problem.

Developing product forms with market acceptance and without the constraints of high transportation costs will revolutionize Alaskan shellfish market competitiveness. Identifying the obstacle of transportation, and conducting research to overcome the barrier, demonstrate clearly why research and development are needed to propel the Alaska shellfish industry .



Freezing technology for greenlip mussels dramatically expanded markets in New Zealand

Taking Oysters to the next level

Oyster culture is currently leading shellfish industry growth in Alaska. Research and development in the oyster industry has contributed to this growth. Over the last ten years oyster harvests have gone from 770,550 to 1.273 million with revenue nearly doubling. In 1996 sales of oysters were $285,778 and in 2005, oyster farmers received $536,813. (Table 3) Over that same time clam harvest grew from 16,593 pounds to 41,804 pounds. Revenue from clams more than doubled, from $43,796 in 1996 to $100,097. By contrast mussels and other shellfish, including scallops, have had less success.

Table 3. Statewide Aquatic Farming Production and Value at Point of Sale

Year	Southcentral Alaska SC AK Oysters	Mussels	Other	TOTAL	Southcentral Alaska SC AK Oysters	Clams	Other	TOTAL	STATEWIDE TOTAL
1990	$22,838	$175	$0	$23,013	$27,626	$0	$0	$27,626	$50,640
1991	$26,612	$26,658	$0	$53,270	$41,457	$0	$0	$41,457	$94,727
1992	$55,450	$19,500	$0	$74,950	$75,090	$4,665	$0	$79,755	$154,705
1993	$81,876	$7,000	$0	$88,876	$86,842	$0	$0	$86,842	$175,718
1994	$120,619	$6,258	$0	$126,877	$136,239	$18,238	$0	$154,478	$281,354
1995	$102,541	$9,904	$0	$112,445	$158,461	$28,118	$0	$186,580	$299,024
1996	$63,582	$16,537	$0	$80,119	$222,196	$43,796	$2,200	$268,192	$348,311
1997	$96,472	$13,366	$0	$109,838	$202,965	$93,869	$0	$296,834	$406,672
1998	$155,160	$12,537	$0	$167,697	$226,415	$89,002	$417	$315,836	$483,534
1999	$180,981	$11,586	$0	$192,567	$187,605	$124,054	$0	$311,659	$504,225
2000	$163,703	$7,014	$1,256	$171,973	$146,510	$120,636	$0	$267,146	$439,119
2001	$175,034	$4,636	$1,617	$181,287	$105,018	$105,071	$150	$210,239	$391,562
2002	$275,422	$5,419	$2,066	$282,907	$124,770	$115,038	$345	$240,153	$523,060
2003	$307,047	$6,484	$0	$313,531	$163,908	$148,924	$210	$313,043	$626,573
2004	$284,495	$3,045	$0	$287,540	$187,448	$156,921	$2,612	$346,981	$634,522
2005	$332,749	$6,308	$0	$339,057	$233,215	$103,772	$0	$336,988	$676,045

Source: Alaska Department of Fish and Game/Division of Commercial Fisheries
Contact: Cynthia Pring-Ham (Cynthia_pring-ham@fishgame.state.ak.us

The science, technology and markets developed for Alaska oysters help pave the way for other shellfish culture and marketing. The experience of oyster growing in Alaska in the last two decades illustrates the critical role of supporting the industry with research, development, demonstration and training. This support has removed many constraints and brought the Alaska oyster industry to a point where it is poised to accelerate to the next level of industry maturity and production. The OceansAlaska Marine Science Center will provide continuing research and development to support this next step in Alaska's oyster industry.

Geoducks

British Columbia currently harvests four million pounds of geoduck annually, resulting in a $40 million wholesale value. Washington State also harvests approximately four million pounds annually with a wholesale value of $35 million. Both of these fisheries are mature and will produce no more on their own. However, the enormous profitability of live geoducks has spurred government sponsored research in both British Columbia and Washington to increase cultural production of geoducks to enhance industry productivity.

In Washington, the cultured production of geoduck began more than 20 years ago and has expanded rapidly in recent years to a harvest of 850,000 pounds in 2005, or one quarter of the total harvest .

Washington geoduck farms with intertidal planting

In British Columbia, between 250,000 and 700,000 seed have been planted every year since 1997 with the goal of replacing half the annual commercial harvest. Although it is too soon to determine the success of the Canadian enhancement program, the government has established the Centre for Shellfish Research in Nanaimo, to support the effort with research and development. The Centre is driven by an industry-developed list of research and development needs.

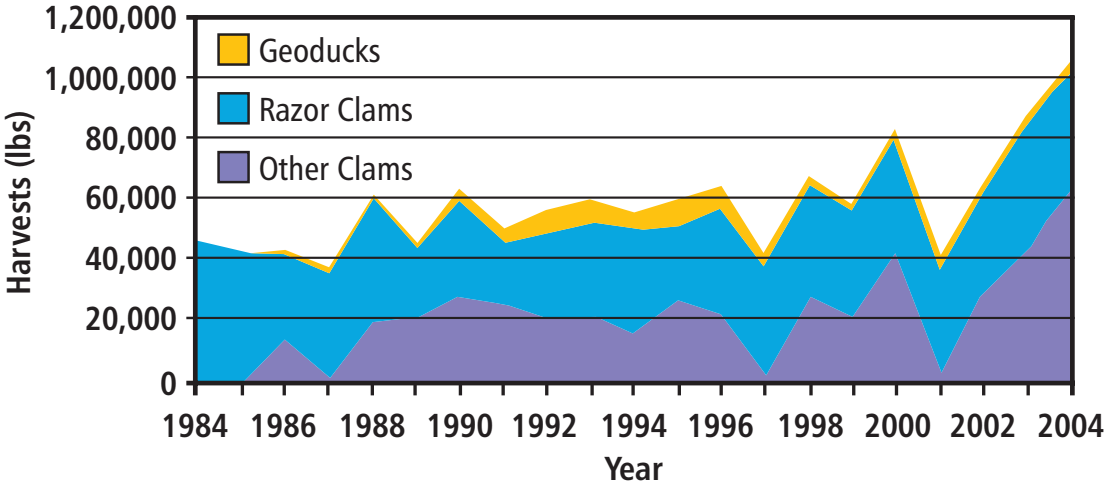
Both Washington and British Columbia depend upon research and development sponsored by the government and co-directed by industry to identify industry needs and challenges to improve their geoduck industries[6].

Alaska, by contrast, has had a small commercial geoduck fishery in Southeast since the early 1980s. However, recently, with the help of a successful Paralytic Shellfish Poisoning (PSP) monitoring plan that makes it possible to market live Alaskan geoducks, interest in geoduck farming and enhancement is skyrocketing, creating a need for more research and development .

Geoduck clams harvested by divers

Since the late 1980s Alaska's geoduck fishery has grown slowly with fits and starts due to regulatory, budgetary and scientific knowledge constraints. The typical harvest has been 200,000-300,000 pounds annually but has nearly doubled with improved state surveys. (Table 4) In 2005, 530,000 pounds were harvested with a value of $2.12 million according to the Alaska Department of Fish and Game.

Table 4. Clam harvests in Alaska are on an upward trend after years of up and down production.



Source: Alaska Department of Fish and Game, Division of Commercial Fisheries, Annual Mariculture Report, 2003.

It wasn't until 2002 that the profit potential of the geoduck harvest really took off. That's when the Alaska Department of Environmental Conservation and Southeast Alaska Regional Dive Fisheries Association (SARDFA) established a more efficient Paralytic Shellfish Poisoning (PSP) monitoring plan. Test results are posted online immediately after being entered into the database, which allows more of the geoducks to enter the market live, not processed. The market price for live geoducks is $5 to $10 a pound, for processed it is less than $2 a pound. According to SARDFA, 90% of the 2004-2005 commercial season harvest was delivered live. Prior to this time a highly restrictive sampling protocol was a significant barrier to the success of the geoduck fishery[7].

[6]For more information and references on geoduck farming in British Columbia and Washington State, see Appendiz J.

7Carroll, A. Alaska Department of Fish and Game Wildlife News, *Geoducks: Southeast Gets a Toehold in the Market: World's Largest Burrowing Clam Can Live 140 Years.* October 2005.

Regulations constrain geoduck farmers

Geoduck diver at work harvesting clams

An average geoduck farm site is about six acres. Sites must be surveyed to make sure that there are no more than 12,000 pounds of wild geoducks already existing on the farmsite (2,000 pounds per acre). Every two years, the Department of Natural Resources (DNR) provides an opening from January to April to apply for a tidal submerged land lease. A lengthy, multi-agency six-month review of the application is completed; and if it meets all the state regulatory review standards, a lease from DNR and an operation permit from the Alaska Department of Fish and Game (ADF&G) are issued for a 10-year period. Recent legislation and court rulings have made it clear that sites that attract or support a commercial fishery will not be granted an operation permit. In the past, these regulations have proved cumbersome. (Appendix H) As a result, the department is working with the farmers to find ways to decrease the survey costs and time that it takes to do them, so data is more readily available to the department for making this decision. Still, delays in issuing permits may occur due to current limitations on how many surveys can be done by the department each year.

Despite constraints, interest in geoduck farming is booming with the increased values for geoduck with the PSP regulation changes. "In the recent 2005 aquatic farm opening, over 97 percent of the 141 proposed aquatic farm sites are for culturing geoducks," said Cynthia Pring-Ham, Mariculture Coordinator for ADF&G.

Geoduck Farming and Enhancement Projects Underway

Farming

Currently 105 acres are permitted for geoduck farming in Alaska with an additional 176 acres approved. Alaska allows both subtidal and intertidal farming of geoducks, although most of Alaska's geoduck farms are subtidal, meaning that they are located on the ocean bottom, below the low tide point that is never bare. Intertidal farming occurs on the range of beach strata from high tide to low tide. In the wild, geoduck live mostly in subtidal range, but the top edge of the population extends into the intertidal[8].

Alaska's first geoduck farming project began in 2002. Since geoducks can take close to ten years to mature, it is too soon to know the success of current efforts at enhancement, however early indications are very encouraging.

In 2002, a pilot project for intertidal geoduck aquaculture was initiated as a cooperative research project between Annette Island Indian Reserve and the Alaska Sea Grant Marine Advisory Program aquaculture specialist. Growout results from measurements taken 18 months later showed 44.16 mm shell length compared to beach cultured clam from the State of Washington at 57.5 mm. These results are very promising since the seed available for the growout study were small. Since then, research and development have provided larger seed and nursery culture systems that will improve performance. Two additional sites were planted with seed in the spring of 2004.

[8]By contrast, Washinton only allows "farming" in the intertidal range. Cananda allows only enhancement in the subtidal range. This means that Alaska will have its own individual needs for research and development.

The first subtidal geoduck farmsite was planted with hatchery seed in 2003. Since then an additional seven subtidal farm sites have been seeded. The number of seed or spat planted was relatively small, but included all the geoduck spat the Alutiiq Pride Shellfish Hatchery could produce in the early stages of development. Growth rates in the subtidal plots are unknown, but the few uncovered by farmers appear to be growing quite well.

In 2003 two geoduck projects received grant funding and were underway in Southeast Alaska. One project was conducted by Krestof Clam Company in Juneau and Sitka as an intertidal farming project. The second project was conducted by a partnership of ADF&G and geoduck divers 60 miles south of Ketchikan as an enhancement project.

Geoduck clam feeding on the sea floor

Geoduck farmers are learning from these early aquaculture efforts. Ketchikan geoduck farmers have built a nursery system so they can plant larger seed. The Alutiiq Pride Shellfish Hatchery in Seward is now able to provide geoduck seed for both enhancement and Alaska farmers. While three other out-of-state hatcheries could potentially provide geoduck seed, Alaska law and regulation effectively prohibit the importation of shellfish seed, except for Pacific oysters. And, at the Alutiiq Pride Shellfish Hatchery, significantly large volumes of hatchery seed should be produced this year.

Enhancement

The Southeast Alaska Regional Dive Fisheries Association (SARDFA) and ADF&G are currently conducting a Geoduck Enhancement Pilot Project near Ketchikan. The main goal of the project is to ensure sustainability of the geoduck resource and to ensure the long term success of the geoduck fishery. This pilot project is the first step in the long-term development of a sustainable enhancement program.

Research will provide blueprint for sustainability and success by addressing the following questions:

- *How to develop successful enhancement techniques*
- *How survival rates are affected by site selection*
- *How growth is affected by planting density*
- *How to sustain a long-term enhancement program*

Potential of Farming and Enhancemenet of Geoduck

It is difficult to accurately forecast the potential of both farming and enhancement of geoduck in Alaska. Research and development are in the early stages, but have eliminated some of the constraints. Our neighbors, British Columbia and Washington State, provide examples of mature fisheries with growing enhancement programs. However, geographical, climate and regulatory differences make direct comparisons imprecise. Yet both British Columbia and Washington have benefited immensely from a sustained government-funded research and development program to develop their shellfish industries.

According to an informal survey of geoduck farmers, current investment and business plans for geoduck farming in Alaska are based on a growing density of geoducks of one per square foot, or 43,000 per acre. If we use Washington performance standards, geoducks would grow to maturity in 10 years at two pounds; this would yield 86,000 pounds

in ten years, or 8,600 pounds per year. At this rate, 120 acres could produce one million pounds per year[9]. Alaska does have some advantages over other places where geoducks are farmed. Lack of pollution and the farming of subtidal bottom greatly expand the available lease sites. This is in marked contrast to Washington where farming of geoduck has been legally limited to the intertidal zones, and where pollution has eliminated 22% of the commercial fishing grounds from harvest.

Although it is difficult to estimate enhancement potential at this early stage, based on known density successes in Washington and available geoduck beds that could be accessed for enhancement, millions of pounds are a conservative projection.

Strong market demand for Geoduck clam creates the potential for jobs in coastal Alaska

[9]The author of this report interviewed Alaska geoduck farmers and asked about their investment criteria. Projections are based on these interviews along with typical performance of Washington geoduck farms. Even allowing for smaller growth and longer growout, the potential of Alaska geoduck is still great.

Tackling Constraints to Shellfish Industry Expansion

While currently a cottage industry, shellfish aquaculture is growing and offers potential for an industry worth hundreds of millions of dollars. The growth of this industry to date has been slow, constrained in part by:

- *A restrictive regulatory climate*
- *The high cost of doing business in rural areas of Alaska*
- *A lack of investment capital, and*
- *Limited government support in research and development and training*

--Raymond RaLonde, Aquaculture Specialist
University of Alaska Sea Grant Marine Advisory Program

Alaska's fledgling shellfish culture and enhancement industry has come a long way since the 1988 Aquatic Farm Act authorized the first shellfish farms and hatcheries. Now the Alutiiq Pride Shellfish Hatchery in Seward is successfully producing native seed, a paralytic shellfish poisoning monitoring plan allows Alaskans to market live geoduck for significantly higher prices and FLUPSY has increased the survival rate of oyster broodstock and halved the growing time. These and other advances through research and development over the past two decades have brought Alaska's shellfish industry far, but a wide array of constraints and barriers still face the industry before it can realize its great potential for being globally competitive and a sustainable economic engine for coastal communities.

Constraints are nothing new to Alaskans in the development of viable economic businesses. The large, profitable and modern Pollock and whitefish industry in the Bering Sea, Aleutians and Gulf of Alaska is just one example of a potential industry becoming a reality. The establishment of the 200-mile limit, with passage of the Magnuson–Stevens Act by Congress in 1976, tipped the balance in favor of the groundfish industry. In the decade following that tipping point many obstacles of technology, financing, training, transportation and infrastructure had to be resolved. With their resolution came a multi-million dollar industry that now supports coastal communities throughout Alaska[10].

Shorebased surimi processing in Alaska developed after research, development and demonstration projects proved the ability to compete with foreign offshore processors.

Alaska's shellfish industry is now at a point where, with focused attention to removing obstacles and constraints, it can take advantage of the vast potential of Alaska's maritime coastline.

[10]Surimi and pollock from the groundfish fishery bring in $800 million a year and development of the flatfish fishery contribute an additional $15 million a year according to Alaska Fisheries Development Foundation. For more information on how R&D contributed to this lucrative fishery go to www.afdf.org.

Our survey of industry constraints and barriers finds a wide range of challenges. Each species has its own unique list of challenges. Oysters have fewer barriers because they have been cultured for the longest time in North America and Alaska. Geoduck clams have a recent history of success in Washington and British Columbia but face many more challenges than oysters due to shorter time being cultured. We are just beginning to discover the potential for commercial production of Littleneck clams in Alaska[11].

Barriers to Alaska Shellfish Culture and Enhancement Are:

- ***Research funding for shellfish is limited.*** *Political priorities of the nation are driving national research priorities and the potential of Alaska shellfish is not on the national priority screen.*
- ***Industry Struggling to Emerge.*** *Alaska's shellfish farms are largely "mom-and-pop" affairs, undercapitalized and struggling. Large companies that exist in other mature industries which could lend financial support do not exist at this stage.*
- ***Species Diversity is Needed.*** *A healthy viable industry will require multiple species to cope with market fluctuations, diseases, cash flow, economies of scale and seasonality limitations.*
- ***Regional Differences can be Great in the Greatland.*** *What works well in Kachemak Bay may not be duplicated in Southeast because the oceanographic conditions vary so dramatically.*
- ***Market R&D is Necessary and Challenging.*** *Many species are developed because they do well in aquaculture settings and markets must be developed as production grows.*
- ***Research Coordination is Needed.*** *The potential exists to conduct coordinated research projects from Ketchikan to Kodiak, but there is limited collaboration and very little communication.*
- ***Costs are High in Alaska.*** *Not only in rural Alaska, but in all of Alaska, the cost of doing business is high.*
- ***Lack of Best Practices in a Startup Industry.*** *Technology, management and business practices have yet to be determined that are "Alaska specific." As a new industry of shellfish growers is created there is no pool of experienced know-how to draw upon.*
- ***Supportive Regulatory Environment.*** *Success stories for aquaculture all point to the need to develop a regulatory framework based on solid science that supports industry growth and development. Alaska has made significant progress, but will need to continue to adapt .*

The Louisiana Shellfish Research Center supports a large shellfish growing industry

[11]For a detailed description of barriers see Appendix H.

The OceansAlaska Marine Science Center Will Help Industry Overcome Barriers

The OceansAlaska Marine Science Center will assemble a team from industry, community and government sectors to systematically define and update research and development priorities for the industry. By doing this, the Center will provide a focal point for the industry to systematically address the entire host of constraints and barriers. The Center itself will focus on research, development, demonstration and training projects that assist the industry in overcoming barriers for each species, creatively developing strategies and methodically, over time, working to overcome the constraints to industry growth.

The Center's process for addressing constraints and barriers is similar to government funded aquaculture research and development programs around the world. Sustained research and development in places such as New Zealand, British Columbia and Japan have already tipped the balance and spurred shellfish industry growth to the next level.

Success Stories in Shellfish Culture and Enhancement: New Zealand, Japan and British Columbia

It is often said that Alaskans like to do things their way. But as the world gets smaller and smaller and other places face similar challenges, it is of great benefit to learn from the experience of others and adapt it to our needs. New Zealand, Japan and British Columbia have invested in research and development in their aquaculture programs over the past decades. As a result, New Zealand has seen a six fold increase in harvest value of its greenlip mussels; Japan's scallop production has grown from 10,000 tons to 500,000 tons; and British Columbia has estimated the potential for culture-based shellfish fisheries to be $760 million and is developing a systematic government-funded research and development program to reach that potential.

New Zealand Greenlip Mussels

New Zealand supplies 90% of the frozen mussels for the United States' market and is a market leader. Alaska can draw from the many reasons New Zealand has succeeded despite its high costs and remoteness from markets. One of the major themes of New Zealand's success is the creation of mechanisms for the industry and government to work together to solve problems facing the industry .

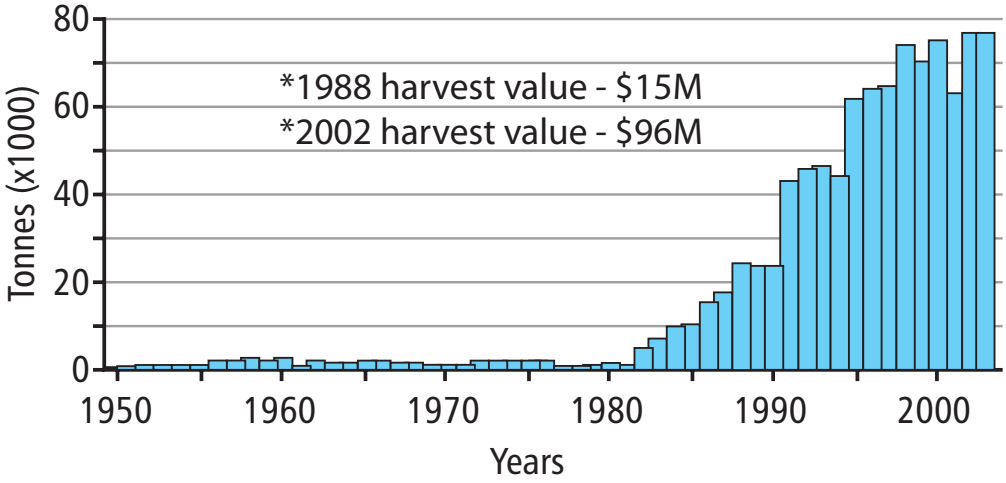
New Zealand provides an excellent case study for comparison with Alaska for many reasons. Both New Zealand and Alaska have small populations, strong fisheries sectors, unpolluted coastline, large distances to primary markets and dependence on export markets. Both are also developed nations with "expensive" labor, regulations and infrastructure costs.

While other species such as oysters, clams and abalone are farmed in New Zealand the majority of production is the greenlip mussel (Perna canaliculus) which is marketed under the registered name Greenshell® mussel.

In 1972 the New Zealand Fishing Industry Board initiated a research and development program in the Marlborough Sounds. This program brought about the establishment of the Japanese longline method of cultivation and found answers to the essential matter of regular and reliable supply of seed mussels.

New Zealand Greenlip Mussels are known around the world today

Figure 3. New Zealand Mussels: A Success story.



After a concerted research and development program, New Zealand's greenlip mussel harvest grew five fold in fifteen years. Source: New Zealand Seafood Industry Council (2005). New Zealand's Principal Seafood Exports: 2000-2004 from http://www.seafood.co.nz/
*Numbers have been converted to US dollars.

Since that time mussel farmers have made improvements to the longline technique, transfer of spat, growing strategies and harvesting methods. Gear, equipment and vessels, once copied or borrowed from other uses, are now designed and manufactured in New Zealand expressly for the mussel farming industry. As the industry has grown, the vessels used for mussel farming have changed from small launches or fishing vessels to large self-contained harvesting units that employ a crew of three and up to six depending on size. The larger vessels can harvest in excess of one hundred tons of washed, separated, ready- for-processing mussels in a day.

Marine biologists and technicians have provided essential research leading to improved productivity and greater environmental understanding. Processors have developed state-of-the-art processing plants operating under strictly monitored hygiene and quality control regimes.

Greenlip Mussel farms are located in many New Zealand bays

Greenshell® mussels in a variety of product forms are currently exported to some 55 countries worldwide. New Zealand supplies over 90% of the frozen mussel product consumed in the United States. Many other growers in North America are thousands of miles closer to the market, but distant New Zealand growers have grown a competitive product and industry. One driver of this success has been the 15% annual growth in mussel consumption in the U.S. Not only has New Zealand grown its sales in the U.S., but it has also achieved market leader status.

In 1988 New Zealand exported 12.8 million pounds of mussels. Exports have grown 520% to 67 million pounds in 2002, at a value of $96 million. (Figure 3) The industry has increased the proportion of product exported as value added products during this same time period, increasing average value yields.

At present there are 605 mussel farms encompassing 7,000 acres in New Zealand. This represents an export return of $13,600 for each acre used for mussel production. By comparison, Alaska currently has 50 aquatic farms on

237 acres with a return of $2,300 per acre. The New Zealand mussel industry provides direct employment for 1,600 people on a full time basis with total salary and wages of $21 million a year. In Alaska, revenue per job is $23,000. (Table 4)

Continuing Commitment to R&D in New Zealand Brings Results

New Zealand maintains an aggressive and expansive research and development program supporting the growth of the mussel, shellfish and aquaculture finfish species. The industry organization, New Zealand Mussel Industry Council, supports a wide range of functions for its industry members including research[12].

The non-profit Cawthorn Institute, located in Nelson, New Zealand, has a long history in shellfish and aquaculture research. The Glenhaven Aquaculture Centre facility maintained by Cawthorn is dedicated to shellfish research and development projects. The for-profit National Institute of Water and Atmospheric Science (NIWA) is a large, diversified organization that includes the National Centre for Fisheries and Aquaculture specializing in the seafood sector. NIWA maintains five research and development stations in New Zealand, two of which are joint ventures with universities.

The New Zealand national government funds research and development through the Foundation for Research, Science and Technology (RS&T) with $312 million annually. These funds are distributed based upon a long-term strategic plan and through a competitive grant process. The aforementioned organizations receive funding from RS&T. New Zealand universities also maintain very active programs in basic scientific research that supports the shellfish industry and the various research and development programs that focus on applied research.

This commitment to research and development has allowed the New Zealand greenlip mussel industry to overcome the initial roadblocks to industry viability, to become globally competitive and to resolve environmental issues as the industry has expanded. This support is demonstrating the same success in other mariculture industry sectors now. Research and development is now aimed at developing new species – kingfish, crayfish, eels, groper, abalone, clams and kina.

Lessons Learned from the New Zealand Experience

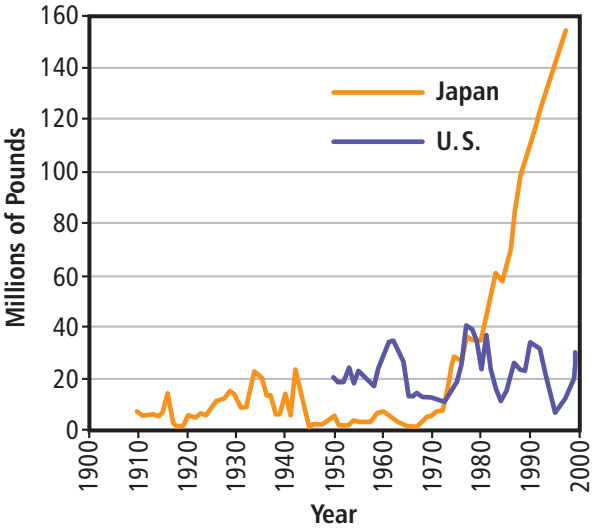
Much of New Zealand's success is derived from the collaboration between industry and government to solve problems facing the industry. Some lessons learned from New Zealand are:

- *Publicly funded research and development play a prominent role in overcoming barriers*
- *Product form innovation overcomes transportation disadvantages*
- *Industry needs to work together toward a common goal*
- *Single production and harvesting technique create synergies*
- *Capitalized production and increased mechanization offset cost disadvantages*
- *Effective generic marketing campaign helps penetrate new markets*
- *Value added products help overcome cost and market barriers*
- *Leadership in product quality and safety are important to market success*
- *Leadership in environmental management systems create a sustainable industry with public and government support*

[12]The current listing of research projects can be found at http://www.nzmic.co.nz/Highlights.aspx

Japanese Scallops – A Case Study for Alaska

The Japanese scallop industry today is very mature and harvests exceed $400 million annually in ex-vessel values. Based on the pioneering leadership of Japan worldwide production of scallops has increased and today three-quarters of world production is achieved by aquaculture. While original culture and enhancement efforts started in the 1930's, the growth of the industry took off in the 1970's.[13] Since that time production has expanded from 10,000 tons to over 500,000 tons of very stable harvests. (Figure 4)



Source: This graph is retrieved from http://www.seascallop.com/Japan.html

Figure 4. U.S.-Japan Scallop Landings Comparison

There are many similarities to the challenges for Alaska shellfish industry. The Scallop industry is based on harvest of a native scallop in both the wild fishery and cultured through both bottom growing, hanging nets and hanging lines. The fishery is centered in the cold waters of northern Japan which are stormy and exposed to the open North Pacific. Japan has high labor, energy and real estate costs. It also has a very mature commercial fishing fleet and processing industry within which the culture industry had to develop.

Research and development played a key role in the growth of the scallop industry. It is an on-going priority of government, fishers and the private sector to develop and improve enhancement and grow out technology. Government also directs resources at developing technologies to assist the industry. Scientific research actively supports enhancement activities. This includes providing direction of spat collection and propagation and when to harvest marketable scallops. These activities are conducted through "fishery research centers".

Japanese Scallops and scallop boat

Japanese Scallop System

[13]Spencer, B. E. *Molluscan Shellfish Farming, pp. 166-169*, 2002.

The success of the Japanese scallop industry has been studied by many other jurisdictions and emulated around the world as a model.

Lessons that apply to Alaska:

- *Native scallop is the basis of the industry*
- *Wild harvest, enhanced culture and intensive culture methods are all utilized*
- *Government supported research centers play a key role*
- *Collaboration between private and government sectors is essential to resolve roadblocks*
- *Government regulations are flexible and allow different industry development patterns to meet local needs and challenges*

Table 5. Aquatic Shellfish Farming Production comparing New Zealand, British Columbia and Alaska.

Aquatic Shellfish Farming Production*

	New Zealand	British Columbia	Alaska
Number of Farms	605	482	50
Area (acres)	7,000	5,300	237
Tons	28,069	9,300	480
Value Million	$ 96 M	$ 23 M	$ 634,000
Value/acre	$ 13,700	$ 4,300	$ 2,700
Value/farm	$ 159,000	$ 48,000	$ 12,700
Jobs (FTE)	1,585	700	27
Revenue per Job	$ 60,600	$ 32, 800	$ 23,000

Source: Exports of Seafood Produce for 12 Months ending December 2004. Prepared by the Information Centre, NZ Seafood Industry Council (SeaFIC), from official export figures collected by NZ Customs and supplied by Statistics New Zealand.
*All figures have been converted to US dollars.

British Columbia invests in R&D to reach shellfish potential

Although British Columbia has the advantage of closer proximity to markets, it shares with Alaska a similar coastline, species mix, cost of doing business, and commercial seafood industry. Like Alaska, British Columbia has a fishery industry dominated by wild capture fisheries and significant dive capture fisheries. But unlike Alaska, it has been investing steadily in research and development to grow aquaculture.

British Columbia shellfish farm

British Columbia has emphasized growing its shellfish aquaculture and salmon farming as traditional wild capture fisheries have matured or declined. Aquaculture constituted 28% of the wholesale value of British Columbia fisheries products in 2004 at $257 million. Shellfish aquaculture provided 12% of the value of all shellfish products in British Columbia. Oyster culture dominated with 82% of the volume of farmed shellfish production.

While the area under cultivation and the number of farms in British Columbia are about two thirds of New Zealand's, the value of these farms is less than a third and the revenue per job about half. (Table 4) It is disparities such as these, among others, that have led British Columbia to look for ways to reach its potential in the shellfish industry.

Shellfish potential in Canada

Both industry and government see a vast potential for culture-based fisheries in British Columbia. The National Office of the Commissioner for Aquaculture Development prepared a national study in 2001, "Economic Potential of Sea Ranching and Enhancement of Selected Shellfish Species in Canada." The study concluded that "culture-based shellfish fisheries could eventually generate a landed value in the range of $1 to 1.5 billion annually on Canada's Pacific and Atlantic coasts. These fisheries would create or stabilize thousands of jobs, and strengthen many coastal communities." The British Columbia potential for shellfish culture was estimated as $760 million.

In 2002 a more detailed study was conducted to determine what would be needed to reach that potential. "Profile and Potential of the BC Shellfish Aquaculture Industry 2002" reported a long list of constraints and roadblocks bogging down growth of the British Columbia shellfish industry. For those who have attended meetings, conferences and read reports about the Alaska shellfish industry this would be familiar reading.

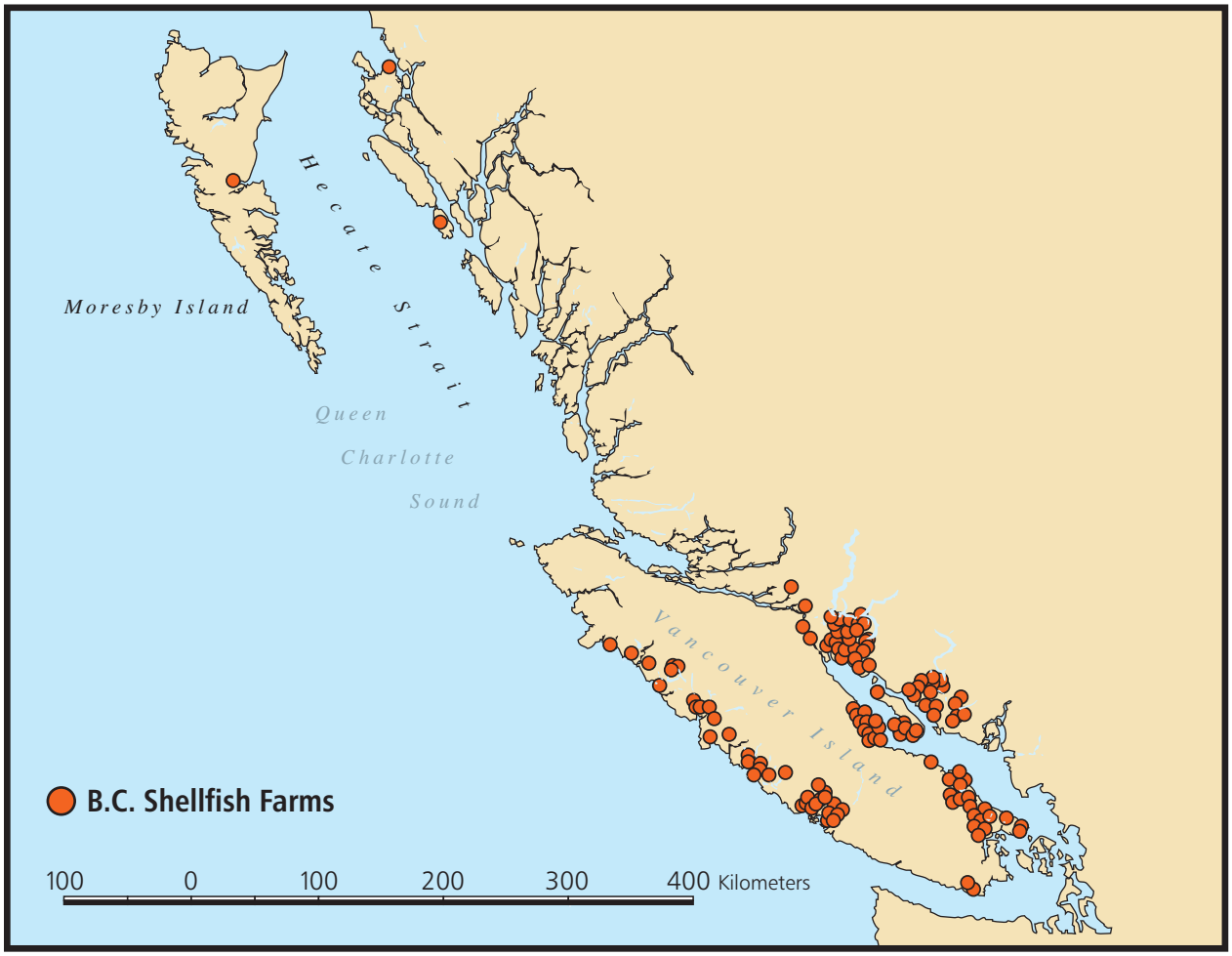
The Centre for Shellfish Research (CSR) was formed by the Canadian and British Columbian governments and the shellfish industry to systematically tackle the barriers to achieving the vision of a large and mature shellfish aquaculture industry. The vision statement of the Centre is:

> *"The Centre for Shellfish Research serves as the West Coast centre of excellence in research to support an internationally competitive, environmentally sustainable shellfish aquaculture industry in British Columbia."*

CSR initiated its existence with a very extensive planning process built around industry needs to focus its limited research and development budget on industry priorities. A strategic research plan was developed for each priority shellfish species as part of this overall effort.

CSR is very integrated and collaborates with other scientific, educational and research organizations and institutions. CSR has entered into several memoranda of understanding (MOU) with research organizations to collaborate and leverage limited budgets.

British Columbia Shellfish Farm Locations



Shellfish farm sites are scattered through the British Columbia coastline

Lessons learned from British Columbia:

British Columbia recognized that although there is great potential for aquaculture along its shores, this potential does not translate automatically to industry growth. Until recently, R&D support has been lacking. In particular, there has been little to develop the culture potential of native species. To address this need and the fact that the initial small companies and entrepreneurs in the industry do not have the resources to fund the necessary research and development, the government is undertaking a focused research and development program. Public/private collaboration is making it possible to share information and develop priorities with limited resources. The result is a common vision and common goals by both the government and industry.

Marine Science Center Business Plan: *Vision, Mission and Measurements of Success*

In 2006, the State of Alaska and Ketchikan Gateway Borough, recognizing the need for research and development of aquatic farming in coastal Alaska, granted 28 acres on George Inlet for the OceansAlaska Marine Science Center.

VISION

The OceansAlaska Marine Science Center will facilitate the emergence of a globally competitive Alaska shellfish industry as a sustainable economic engine for healthy and vibrant coastal communities. The Center will house three integrated marine science functions – research, exhibition and education. The Center will become a respected research, development, demonstration and training organization both nationally and internationally.

MISSION

The OceansAlaska Marine Science Center will focus on research, development, demonstration and training projects that are catalysts for the shellfish industry throughout Alaska. The Center will:

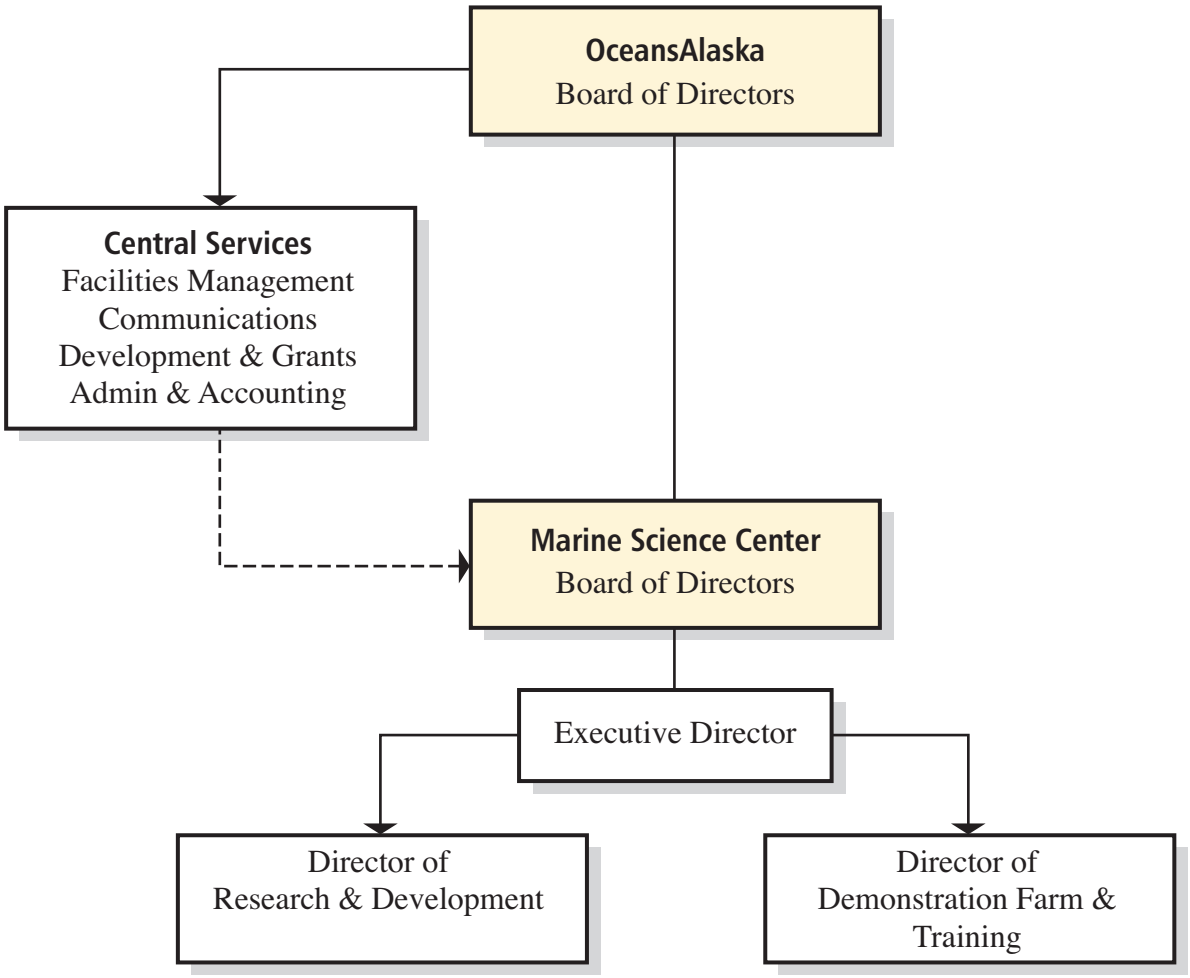
- *Be directed by industry, community and government stakeholders to maintain focus on industry priorities.*
- *Provide a forum and methodology to establish industry research, development and training priorities*
- *Focus on removing industry growth constraints*
- *Provide a sound scientific basis for the sustainable development of the Alaska shellfish industry*
- *Communicate results of relevant research projects to industry*
- *Provide effective demonstration and training programs for the shellfish culture and enhancement workforce*
- *Transfer globally sourced technology to the shellfish culture and enhancement industry*

OceansAlaska site development plans

Measuring the Center's Success

The Center will establish measurements of organizational success that are founded on its mission to be a catalyst in growing the shellfish industry in coastal Alaska. Key growth indicators for each species that is targeted will be devised to measure whether the list of constraints and barriers to industry growth are being removed. For example, an early predictor of success in the production of oysters would be the establishment of broodlines with faster growth and higher survival rates. A later predictor of success would be growth in production of oysters.

Figure 5. Organizational Chart for the Marine Science Center



Operations Budget and Funding for Research, Development, Demonstration and Training

Note: Overhead and administrative costs, such as facilities management, communications, development, grant writing, administration and accounting will be handled centrally at the Center. Revenues from the public exhibition and educational programs will cover these costs, according to a feasibility study already conducted. Because of this structure, the Research, Development, Demonstration and Training Programs at the Center will be able to operate at a significant savings from similar R&D facilities.

Operations Budget

The budget will be $ 460,000 at full operations of all research, development, demonstration and training programs at the Center. Additional budget amounts will be dependent on specific research and development programs and their construct. Many projects will be in collaboration with other institutions and organizations. The detailed operational budget appears in Appendix F.

Funding Sources

Research and development funding will come from a broad array of sources – fees for services, private foundation support, endowments, industry funds, state research grants and federal research grants. Research, development, training and the demonstration farm programs will all have different strategies and sources of funding to be pursued. Funding will be diversified and not overly dependent on any one source.

Foundations

The Center will look to private foundations that have funded aquarium and aquaculture research projects related to environmental issues and sustainability. As pollution and population growth conflicts grow in the continental U.S., Alaska will be a prime candidate for consideration of this type of funding. Private foundations that support aquaculture R&D include Belle W. Baruch Foundation, Culpeper (Charles E.) Foundation, FishAmerica Foundation, Ford Foundation, Kresge Foundation, Jessie Smith Noyes Foundation and the Rockefeller Foundation. Alaska-oriented foundations such as the Rasmuson Foundation, are also potential funders.

The Seattle Aquarium has received funds from several prominent Northwest Foundations and several of these have been for research programs – Bill and Melinda Gates Foundation, Ackerely Foundation, Seattle Foundation, Howard Hughes Medical Institute and the Russel Family Foundation along with many smaller foundations.

The highly successful Monterey Bay Aquarium and its associated research arm, the Monterey Bay Aquarium Research Institute has received major funding support from the David and Lucile Packard Foundation.

USDA Funding

A source of funding for shellfish culture and enhancement may be the U.S. Department of Agriculture, which disbursed more than $2 billion in research and development funds during FY2006.

USDA groups its programs under five strategic goals: (1) enhance economic opportunities for agricultural products; (2) support increased economic opportunities and improved quality of life in rural America; (3) enhance protection and safety of the nation's agriculture and food supply; (4) improve the nation's nutrition and health;

and (5) protect and enhance the nation's natural resource base environment. All R&D programs proposed in this budget fall under one of these five categories.[14]

Although aquaculture is defined as agriculture, only a small portion of these USDA funds are currently dedicated to aquaculture. Also, USDA research funds are distributed through universities and other educational institutions. Typically, these funds reach facilities such as the Tongass Marine Coast Science Center through cooperative arrangements between universities and research facilities. This fits well within the Center's mission to work collaboratively with existing educational and industry resources.

USDA R&D Programs

Money for agricultural research and development flows through the Agriculture Research Service (ARS), which is the USDA's main research agency. USDA also funds the Cooperative State Research, Extension, and Educational Service (CREES), which in FY 2006 provided $500 million to fund research at universities.

USDA also specifically funds pure hard science aquaculture research at the university level through its Regional Aquaculture Centers (RACs). Alaska is part of the WRAC (Western RAC).

Other aquaculture programs include Trade Adjustment Assistance for Farmers (petitions for relief from unfair foreign competition) and AquaNIC (an aquaculture information service).

National Science Foundation

The National Science Foundation provides research funding through its Partnership for Innovation (PFI) program. This program has $9 million nationally with grant awards up to $600,000. The program must be led by an academic organization. Of special note is the number one listed goal of the program, to "stimulate the transformation of knowledge created by the research and education enterprise into innovations that create new wealth, build strong local, regional and national economies and improve the national well-being." This matches up with the goals and methodology of the Center.[15]

Agriculture Research Service (ARS)

The University of Alaska receives funding through USDA's ARS to support a variety of agriculture and fisheries research projects and programs. Roughly half of the ARS funds come from "earmarks" in the federal budget by Alaska's Congressional delegation, mostly as a result of efforts by Sen. Ted Stevens.

The University of Alaska uses ARS funds to support eight scientists and ten technicians, five in Fairbanks and three in Palmer. Two of these researchers work strictly on seafood issues, as a result of earmarks by Sen. Stevens.

Sen. Stevens obtained funding for the fisheries research in 1999 through an earmark and has been able to keep the program funded through ARS since then, according to lead scientist, Dr. Peter Bechtel. Dr. Bechtel spends about a week a month in Kodiak at the Fisheries Industry Technology Center (FITC) and the remaining time at his office on the Fairbanks campus.

Although Dr. Bechtel works in wild fisheries, Sen. Stevens has been successful in showing that the products

[14]AAAS Report XXX: Research and Development FY 2006. Chapter 11; *R&D in the U.S. Department of Agriculture.*

[15]National Science Foundation, www.nsf.gov/pubs/2006/nsf6550/nsf06550.txt

produced in Dr. Bechtel's research are used as feed supplies in fish farming operations and therefore qualify for USDA funding.

Cooperative State Research, Education and Extension Services (CSREES)

The University of Alaska received about $1.5 million in CSREES formula funding in FY2006. About $1 million came from Hatch Act funds, which are distributed to states according to the value of their agriculture crops, and another $500,000 came from McIntyre Funds for forestry work.

The entire $1.5 million pays UA faculty salaries and is matched one to one with state funds, according to Carol Lewis, Dean of the UA School of Natural Resources. According to Dean Lewis this funding may be undergoing changes. The USDA wants to move 60 percent of Hatch Act funds to its competitive grant program to promote multi-state ventures. However, according to Dean Lewis, a Congressional rewrite of the Hatch Act is unlikely, and it is equally unlikely that Congress will shift funds away from the formula approach which ensures each state gets a share.

In addition to Hatch Act and McIntyre Funds, UA receives a considerable amount of CSREES funding through Congressional earmarks. Most of these earmarks – of which there is not an exact accounting according to Dean Lewis – are generated by constituents who convince elected representatives to fund specific projects.

Lewis said UA's agriculture and forestry experimental station has a $10 million research budget, most of which comes from competitive grants.

Strategies for Obtaining USDA Research Funds

Although USDA funds are currently disbursed through the University, there are already underway a number of efforts to steer more USDA funding toward aquaculture research in Alaska. The Center may employ the following strategies to benefit from USDA funding:

- *The Alaskan Shellfish Growers Association (ASGA) has asked Sen. Stevens to secure $400,000 in nearshore shellfish culture and enhancement research and development funds. If granted, some of the funds could be used to help fund operations of a Ketchikan research station.*
- *ASGA requested funds be included in the next Farm Bill for nearshore shellfish culture and enhancement R&D projects. This would result in bringing more CSREES funding to Alaska. Although its inclusion does not seem likely this year, with lobbying help from the Murkowski Administration and a collaborative effort among industry and government, it stands a better chance in the future.*
- *Operators of Seward's Alutiiq Pride Shellfish Hatchery, the Murkowski Administration, and the Alaskan Shellfish Growers Association have been questioning whether CSREES funds currently distributed to UA could be used for shellfish aquaculture research. So far, they have been unsuccessful in getting the University to direct funds to this research. However, as the Center and University collaborate on projects, it may prove to be beneficial to both for this money to be directed more toward aquaculture research.*
- *The Center will work on getting an earmark through Alaska's congressional delegation to establish an Agriculture Research Station in Southeast Alaska with a mission to work on shellfish aquaculture research. Ray*

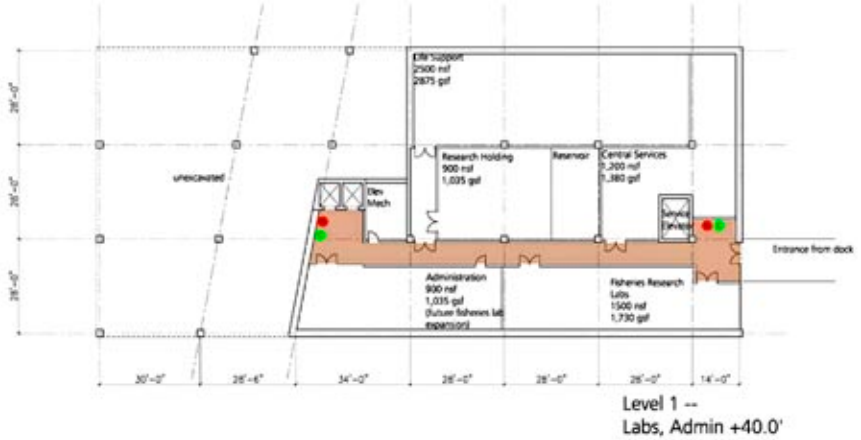
RaLonde, UA Marine Advisory Program aquaculture extension agent, suggests stationing a scientist in Juneau to work out of the UA School of Fisheries and Ocean Sciences laboratory and the shellfish research station in Ketchikan. A connection to the University would help the Center secure funds. Another option is to station an agent at UAS-Ketchikan who would also work at the UAS-Juneau lab. Working through University politics, lobbying the Congressional delegation, and getting funding through Congress might take several years of effort.

- *A long range strategy for the Center is to team up with the two large marine aquaculture research centers on the West Coast: the Mark O. Hatfield Marine Science Center in Oregon and the Pacific Aquaculture & Coastal Resources Center (PACRC) at the University of Hawaii at Hilo. According to UA's Dean Lewis the USDA has an interest in multistate projects and may provide earmark funding for this sort of collaboration. By teaming up with Oregon and Hawaii, it will be possible for Alaska to take advantage of existing research and development and bring Alaska-specific problems into a collaborative, established network.*

Facility Design

Offices, Research Space and Laboratories

Research and development work and facilities will be fully integrated in the design and operations of the overall research, exhibition and education facility. Wet laboratory, dry laboratory, research areas and offices will be located on three floors of the main aquarium building with a total of 4,700 square feet reserved for these specific functions. Drawings for these facilities are shown in Appendix D. The wet and dry laboratories are standard scientific facilities designed for research on marine organisms. This includes design of incoming and out flowing water systems to allow for isolation of water supplies for different projects. Water purification systems are also critical for isolation of various factors in research projects.



Wet and dry laboratories will be integral parts of the planned facility.

The site of the facility is ideal for using pristine and uncontaminated salt water at various depths as the shoreline drops quickly and has good tidal flows. This is ideal for research projects, demonstration mariculture and the aquarium tanks. The site and facilities design will allow for research projects of intertidal, subtidal and suspended aquaculture .

Development and Training Facility Needs

Most oyster farmers are using outdated culture techniques and equipment that contribute to chronic labor problems, extremely poor recovery rates (spat to half shell oyster), reduced product quality and many other inefficiencies, and these bad practices are being passed on to new farming operations.

– From a recent request for state funding by oyster farmers

Providing a user-friendly and effective training program to shellfish farmers will be a priority of the Center. The Center will work with organizations that already provide educational materials to fishers and small businesses in Alaska.

Important to the viability of a training program is the proximity to the UA-Southeast Ketchikan campus, where there are already training programs for salmon hatchery technicians. Officials at UA Southeast Ketchikan have expressed interest in expanding to shellfish. Sheldon Jackson College in Sitka is reviving its long-dormant aquaculture programs, with a new focus on aquatic farming. Collaboration with these two institutions would provide a springboard for launching broad-based training programs, particularly when the resources of the Sea Grant Program are taken into account.

Alaska Sea Grant is the parent body of the Marine Advisory Program (MAP) and provides access to excellent extension program services and support for the publishing of training materials and manuals. MAP, with its long

involvement in providing aquaculture extension services, will be a great asset to the Center's aquatic farm training and technology transfer program. It will also help provide expertise in designing and delivering educational materials.

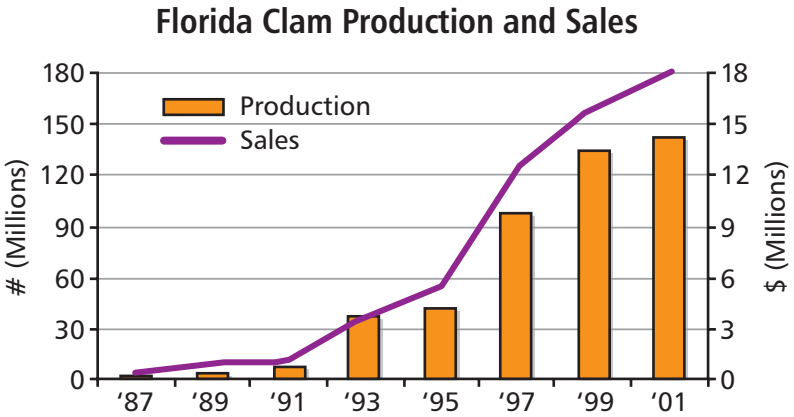
Alaska has a number of programs that assist small businesses in developing business plans, pro forma, financial applications and business management skills. Adapting these to the specific needs of startup shellfish culture and enhancement operations would be of great assistance to their growth and success.

Technology transfer will be an important function of the experimental station.
Technology transfer demonstrations – showing Alaskans aquaculture techniques from outside the state – will be necessary, including adaptations to the specific conditions of Alaska. For example, Alaska oyster farmers could be modeling their operations after suspended tray culture farms in British Columbia, Australia and other regions. One very successful training model comes from the Florida Clam Industry.

Florida Clam Industry Training Provides Model for Center

A model training program has been built in Florida where the state has accomplished wonders working with clam farmers. This program provides a good model for Alaska and the issues facing Alaska shellfish growers.

Florida instituted a constitutional ban on inshore net fishing, creating the need to find new employment for displaced fishermen. The growth of the hard shell clam culturing industry coupled with an innovative training program has been successful in redeploying displaced fishermen .



Florida clam volumes have been propelled by effective training programs

The community-based retraining programs, developed and directed by Harbor Branch Oceanographic Institution's Aquaculture Division, were federally funded by the Department of Labor Job Training Partnership Act. During the 12-month training programs, participants were required to complete course curriculum and hands-on, in-water training.

Participants in the programs trained on "farmettes" of approximately 1,000 square feet of submerged land. They were provided with equipment and three sizes of hard clam seed to experience land nursery, field-based nursery and growout systems. Upon completion of their training, equipment and seed was transferred to the participant's lease. Graduates received a state-owned submerged land lease of up to two acres in size, for a ten-year term.

Since 1994, Harbor Branch has trained nearly 300 fishermen and helped them establish businesses in hard clam aquaculture. The success of these retraining programs has resulted in the implementation of a second generation of retraining programs. Recently, the CLAM II program was funded to provide training for a second group of 44 displaced fishermen and women in the Charlotte Harbor area .

Florida Sea Grant has also played a role in the growth of the clam culture industry. They have cooperated with a number of partners and the industry in providing business management training, nursery technology and seafood safety techniques to create a hard clam industry that did not exist a decade ago.

Florida hard clams

Lessons learned that Alaska can apply:

- *A model farm with crops in various stages of growth to support training programs and demonstration projects is critical*
- *Training should include:*
  - *Culture practices*
  - *HAACP training*
  - *Processing and shipping techniques*
  - *Business management, marketing and sales*

Development and Training Facility Design

Specific facilities will be located on docks and floats adjacent to the Aquarium for development and training programs in the marine waters of George Inlet. (See Appendix D) The facilities will include a FLUPSY, growing floats and operations warehouse. The FLUPSY will allow nursery growout of shellfish seed acquired from State certified hatcheries. Growing floats will allow cages, lanterns and other growing mediums for shellfish. A mobile articulated small crane on the floats will enable working of the growing modules. The warehouse will provide a covered facility for sorting, inspection, cleaning and the many other culture activities that will accompany oyster, clam, mussel, scallop, kelp, geoducks and other shellfish culture techniques. A small office and bathroom are provided on the float to provide support to the training activities. An equipment list appears in Appendix E.

These facilities will be designed with the ability to test new and varied technologies for culturing equipment, and techniques to develop best practices suited to Alaska conditions.

Organizational Structure

Management Structure of the Research, Development, Demonstration and Training Program (R & D Program)

The OceansAlaska Marine Science Center is organized as a 501(c)3 non-profit corporation. The Center is governed by a ten-member board representing a broad range of community interests and expertise. The Center's R&D Program will be directed by an 11-member board .

The OceansAlaska Board has a diverse and experienced membership guiding the project

Seven members of the R& D Board will be chosen from the shellfish culture and enhancement industry in Alaska. They will be broadly representative of all aspects of the industry and capable of defining the key issues facing industry growth and development. The Center will consult with industry and stakeholder groups to ensure broad and effective representation of the industry. Industry groups include, but are not limited to, Alaska Shellfish Growers Association, Southeast Alaska Region Dive Fisheries Association (SARDFA),Kachemak Shellfish Mariculture Association and Pacific Coast Shellfish Growers Association.

The Board will have one member each from the Alaska Department of Fish and Game, Alaska Sea Grant and University of Alaska, National Marine Fisheries Service and the USDA Aquaculture division. These four members will be designated by their respective agencies.

Membership of the R&D Board will include industry and government officials who represent agencies that are involved directly in conducting research as well as funding research by other agencies and contractors. This will safeguard against duplication of research and competition among research organizations. It will also promote co-ordination and inter-agency understanding. To be successful, the R&D Program will operate in co-ordination, co-operation and partnership with the existing State, Federal and Educational institutions operating in the fisheries and oceans areas.

The R&D Board will recruit and hire an executive director who will act as the chief executive of the R&D Program and be responsible for day to day operations. The Board's most important function will be to establish the research priorities for the R&D Program that will facilitate the growth and success of the shellfish industry in Alaska. The Board will also have standard duties and powers of strategic planning, budgeting, contracts and other fiduciary responsibilities.

There will be two operational sections within the R&D Program. The Research and Development section will be directed by a senior research scientist with experience in marine research and management of research operations. The Demonstration Farm and Training Facility will be directed by an experienced aquaculturist. The functions of Development, Communications and Administration will be shared by Center staff to spread costs and create efficiency for the entire organization.

Building an Effective Team

The three critical positions of the R&D Program will be the Executive Director, Research and Development Director and the Demonstration Farm and Training Facility Director.

Alaska oyster farmers are working to diversify with littleneck clams

The Executive Director will be tasked initially with startup and launch of the R&D Program. A critical first step will be the planning process with the industry to define the research, development and training priorities for the industry. Communication with industry, government, research agencies, and the public will be a vital component of the Executive Director's job. Developing and accessing funding for research, development and training projects will be a critical responsibility and conducted with the Development Director of the Center. The Executive Director will need to be a team player, able to integrate and synergize the R&D programs with the visitor and education programs.

The Director of Research and Development will be a respected and experienced research scientist with leadership and management skills. The Director will translate research and development needs of the industry into research projects and create match up with funding and other resources. Collaboration and partnering with other research entities will be key in order to meet research and development needs of the industry. The Director will need to build a talented research team that is able to solve the problems facing industry, including working with the industry in on site projects to leverage limited resources.

The Director of the Demonstration Farm and Training Facility will need educational and communications skills to translate and deploy knowledge, technology, best practices and research results to the industry. Interfacing and partnering with educational programs and Alaska Sea Grant will be essential to a successful program. Devising tools and programs both at the central facility and at remote sites will be needed for an effective program. The Director will need a farming background due to the responsibility for assembling and maintaining a model farm to serve as the base for training, demonstration and integrated research projects.

Setting Research Priorities

British Columbia has effectively used R&D workshops to ensure research is directed at industry priorities

Setting initial research priorities for the R&D Program will be critical, more in depth and more complex at the outset. After a process has been developed and all the stakeholders have participated and learned the process, it will be easier to update research priorities. The process will be built on the research and development processes that have been successfully used by other research facilities such as the Western Regional Aquaculture Center, the Pacific Shellfish Institute and the Centre for Shellfish Research .

The initial process will take one year and be completed before the commencement of construction of the Center facilities. This will allow the Center to incorporate any design changes in construction, equipment and staffing of the Center.

A good starting point for the R&D Program is to review research priorities previously established at industry gatherings, the most recent of which -- "Shellfish Industry: Mission, Priorities and Communications, Planning Session – Outcomes; January 9 and 10, 2006" – was sponsored by the State of Alaska and held in Anchorage. (See Appendix K for the summarized results of the meeting).

The R&D program research priority process will be built around three phases of industry input and participation developed through workshops and conferences.

Phase I *Brainstorm, gather ideas, develop problem statements, define information needs with the focus on industry wide problems*

Phase II *Develop detailed strategic research plans for each shellfish species*

Phase III *Pull it together and prioritize R&D needs*

After each phase, results will be publicized on the Center website, shared with participants and further critical input gathered. Data and backup information will be added to build content and substance around the ideas developed in the workshops and conferences .

Based on the final report, the Executive Director will submit recommendations to the Board of Directors on any necessary changes in the design, equipment, and staffing of the Center; recommendations for collaboration with other research agencies and entities and other changes necessary to meet the R&D needs of the Alaska shellfish industry.

Sea cucumbers are a small but high value seafood production with aquaculture potential and strong global markets

The one-year time frame will allow a solid industry consensus to be developed, ensure wide participation and provide intervening time between public sessions for developing detailed materials and research. It will also be the first vital step toward building the collaborative industry and government environment that will contribute to the Center's ultimate success in addressing R&D and training needs of the shellfish industry. The lesson from other jurisdictions is that successful aquaculture industries are based on the ability to build industry collaboration, consensus and institutions and organizations that support and facilitate those processes.

Interface with other Government Agencies and Memorandum of Understandings (MOU's)

The Center will accomplish many of its goals through collaborative work with other research and education institutions. The starting point for these relationships will be to identify opportunities and define working relationships with formalized "Memorandum of Understandings".

Other research organizations, both in and out of state, may have the leading expertise in a needed area of research. In this situation, the Center's primary role will be to provide the "site" in Alaska for work to get Alaska-relevant data and experience. There is no need for the Center to reinvent the wheel or to build up large overhead attempting to institutionalize expertise in a wide range of areas. In the age of the internet and other communications technology the ability to collaborate on scientific and education projects has been tremendously enhanced.

Organizations identified as primary candidates for MOU's are:

- *University of Alaska*
- *Alaska Sea Grant*
- *Hatfield Marine Science Center - Oregon*
- *Shellfish Research Center – British Columbia*
- *Seward SeaLife Center*
- *National Marine Fisheries*
- *Alaska Department of Fish and Game*
- *Fisheries Industrial Technology Center*
- *Pacific Shellfish Institute*
- *Western Regional Aquaculture Center*

Over time, MOU's will be developed with research organizations in Washington, California, New Zealand and Japan that conduct related research and development.

Startup and Operations

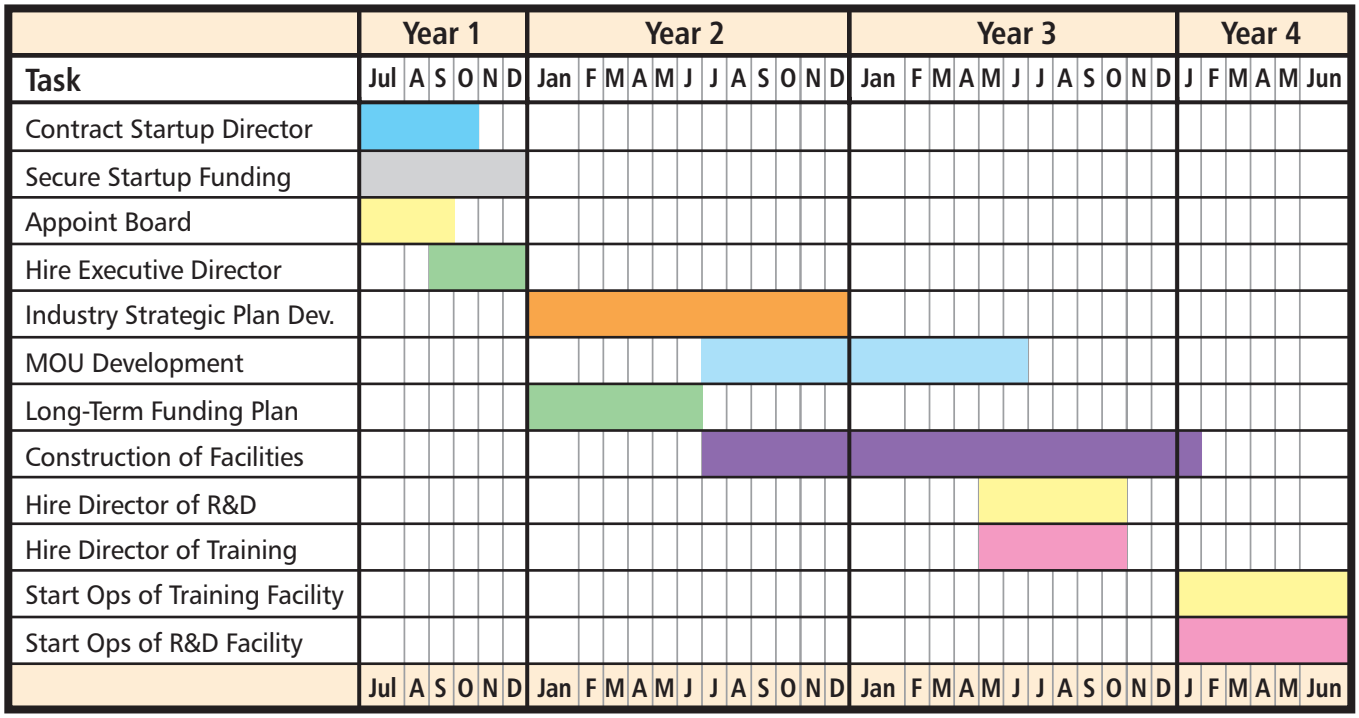
The process to build the R&D Program will start in July, 2006 and be phased in over three years. An interim Executive Director will be hired on contract for the initial startup stage until the long term Executive Director is on board. The OceansAlaska Marine Science Center Board will solicit and appoint the initial Board of Directors of the R&D Program.

The Board initially will focus on hiring an Executive Director, securing startup operational funds and beginning the Industry Strategic Plan Development process. The industry planning process will take one year and be completed by the end of 2007. Long term funding plans will be finalized during this time period.

The Board will utilize its expertise as well as the Industry Strategic Plan to finalize design of the Center facilities. The R&D Program will develop relationships and establish MOU's during this same time period. Construction of facilities will be completed mid 2008.

As the facilities are nearing completion the R&D Program will hire the two key managers to operate the Research and Development Program and Demonstration and Training Facility. Facilities and programs will be in place by the summer of 2008.

Figure 6. Tongass Marine Science Center Operational Timeline



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Appendix A: Alaska Statute 16.40.199

Definitions related to Alaska Aquatic Farm Act

(1) "aquatic farm" means a facility that grows, farms, or cultivates aquatic farm products in captivity or under positive control;

(2) "aquatic farm product" means an aquatic plant or shellfish, or part of an aquatic plant or shellfish, that is propagated, farmed, or cultivated in an aquatic farm and sold or offered for sale;

(3) "aquatic plant" means a plant indigenous to state water or that is authorized to be imported into the state under a permit issued by the commissioner;

(4) "commissioner" means the commissioner of fish and game;

(5) "hatchery" means a facility for the artificial propagation of stock, including rearing of juvenile aquatic plants or shellfish;

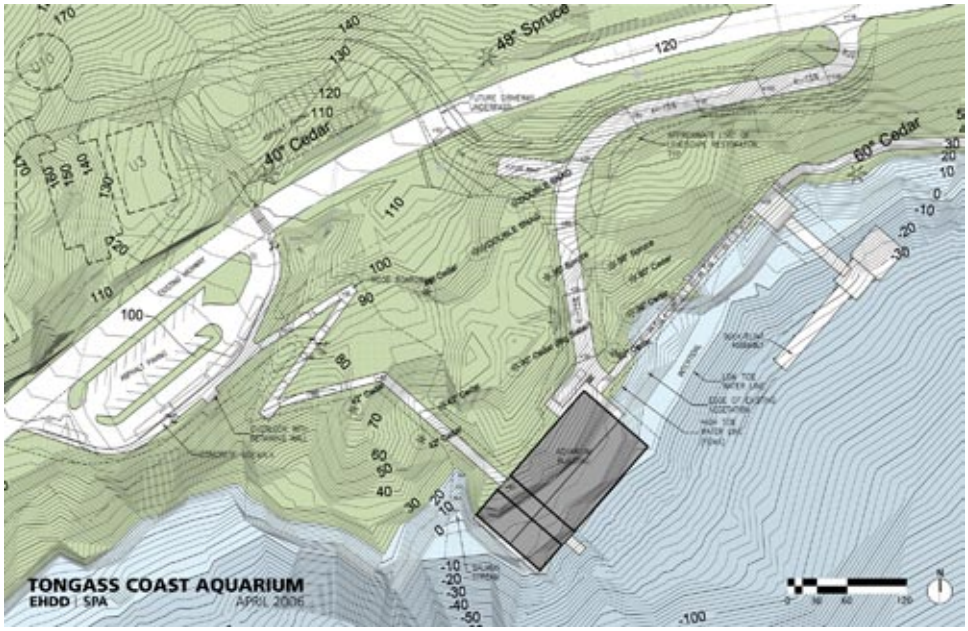
(6) "positive control" means, for mobile species, enclosed within a natural or artificial escape-proof barrier; for species with limited or no mobility, such as a bivalve or an aquatic plant, "positive control" also includes managed cultivation in unenclosed water;

(7) "shellfish" means a species of crustacean, mollusk, or other invertebrate, in any stage of its life cycle, that is indigenous to state water or that is authorized to be imported into the state under a permit issued by the commissioner;

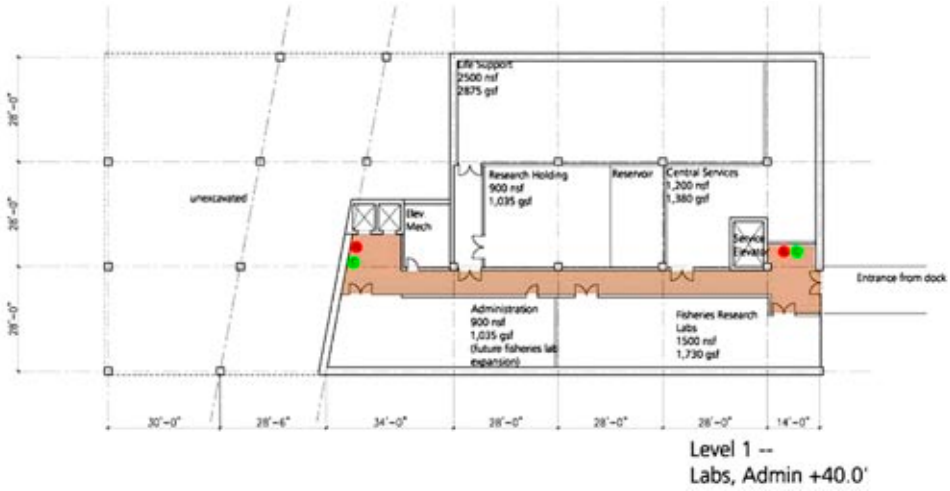
(8) "stock" means live aquatic plants or shellfish acquired, collected, possessed, or intended for use by a hatchery or aquatic farm for the purpose of further growth or propagation.

Appendix B: Map and Site Location

Appendix C: Site Design

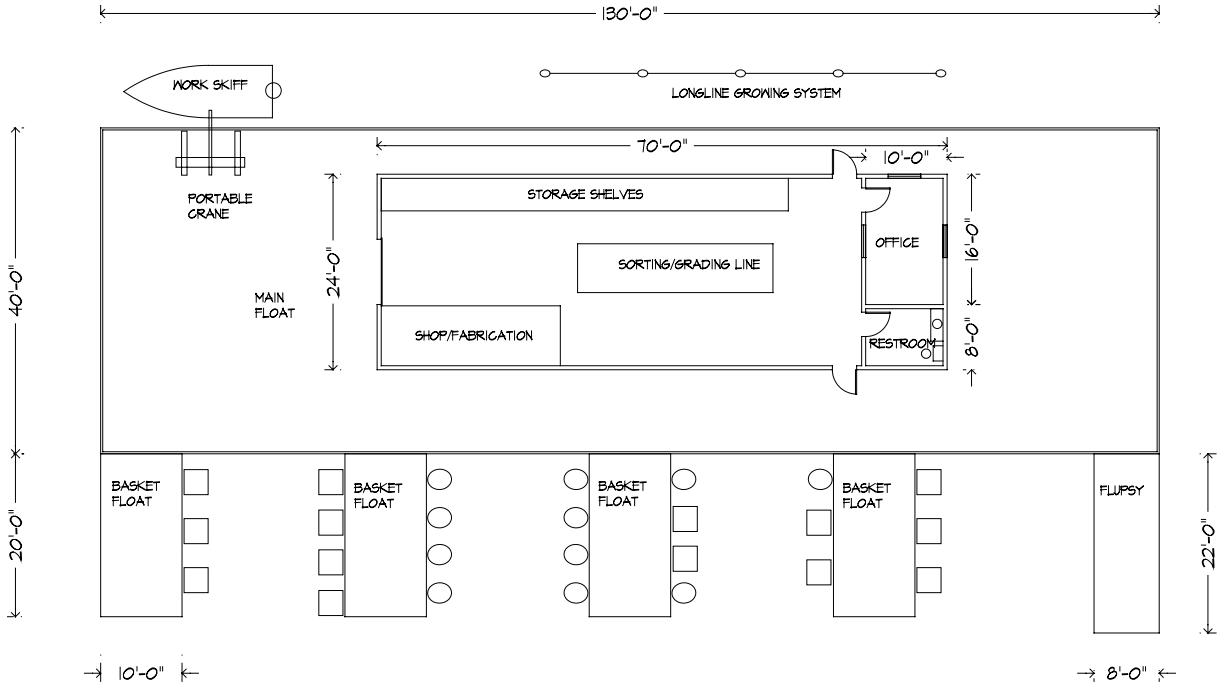


Site topographic map



Laboratory floor plan

Appendix D: Development and Training Facility Plans



1 **FLOAT PLAN**

0' 4' 8' 16'

OceansAlaska Marine Science Center

Demonstration Farm and Training Facility

Appendix E: Development and Training Facility Equipment List and Budget

Development and Training Facility

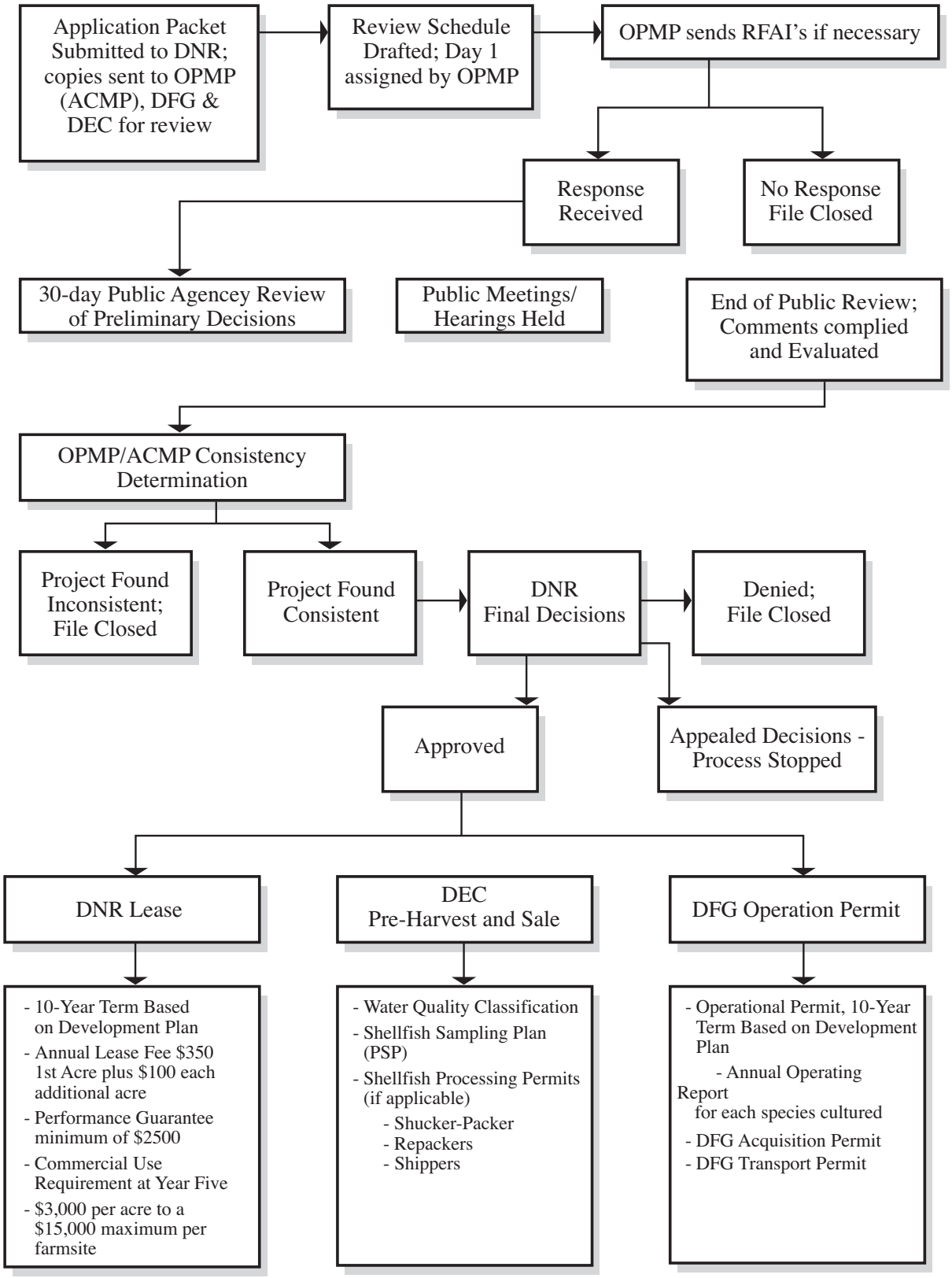
Equipment List

	Cost
Two tumbler/sorters	$8,000
Mobile Pivoting Davit	$3,500
Backup Electrical Generator	$5,000
Computer & Electronics	$2,400
Trays and lantern nets	$5,000
Small longline growing system	$1,500
Tools	$3,000
Totes, buckets, containers	$2,000
Packaging equipment	$2,000
Processing tables	$1,000
Walk-in cooler	$5,000
Stainless steel sinks	$1,500
Hand wash sinks	$400
Storage shelves	$3,000
Skiff and Outboard	$7,500
Safety Equipment	$2,500
Environmental monitoring	$3,500
Miscellaneous	$6,700
Total	**$63,500**

Appendix F: OceansAlaska Marine Science Center Operating Budget

OceansAlaska Marine Science Center Budget													
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Executive Director	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	108,000
Director of R & D	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	96,000
Director of Dev. & Training	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	60,000
Subtotal Wages	22,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000	264,000
Overhead / Benefits	6,160	6,160	6,160	6,160	6,160	6,160	6,160	6,160	6,160	6,160	6,160	6,160	73,920
Subtotal Wages	**28,160**	**28,160**	**28,160**	**28,160**	**28,160**	**28,160**	**28,160**	**28,160**	**28,160**	**28,160**	**28,160**	**28,160**	**337,920**
Staff Travel, Lodging, Meals	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	42,000
Outreach and Dissemination	600	600	600	600	600	600	600	600	600	600	600	600	7,200
Board Travel, lodging,Meals			10,000			10,000			10,000			10,000	40,000
Seed for Demo Farm	500	500	500	500	500	500	500	500	500	500	500	500	6,000
Research Supplies	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	12,000
Conference Expenses	400	400	400	400	400	400	400	400	400	400	400	400	4,800
Publications	400	400	400	400	400	400	400	400	400	400	400	400	4,800
Industry Planning Process	500	500	500	500	500	500	500	500	500	500	500	500	6,000
Subtotal other expenses	**6,900**	**6,900**	**16,900**	**6,900**	**6,900**	**16,900**	**6,900**	**6,900**	**16,900**	**6,900**	**6,900**	**16,900**	**122,800**
Total Expenses	**35,060**	**35,060**	**45,060**	**35,060**	**35,060**	**45,060**	**35,060**	**35,060**	**45,060**	**35,060**	**35,060**	**45,060**	**460,720**

Appendix G: Aquatic Farmsite Program Overview



Appendix H: Constraints to Shellfish Culture and Enhancement

The following constraints are derived from a comprehensive survey of Alaska's aquaculture industry and government experts.

Research funding for shellfish is limited A major barrier to aquatic farm research and development programs in Alaska is the same as it is elsewhere in the U.S.: funding. Shellfish aquaculture research and development funding is scarce and competition is fierce. A "major" shellfish aquaculture initiative by the National Oceanic and Atmospheric Administration has turned out to provide minimal funding for a national effort and has focused primarily on development of offshore growing systems. Political priorities of the nation are driving national research priorities and the potential of the Alaska shellfish is not on the national priority screen.

Industry Struggling to Emerge Alaska's shellfish farms are largely "mom-and-pop" affairs, undercapitalized and most fail to even break even for at least five years. This has been a very common pattern in other jurisdictions. Large companies that exist in other mature industries that financially and professionally can actively participate in projects or contribute much-needed "matching funds" for government grants simply do not exist at this stage in Alaska.

Cooperative research projects tend to get shuffled aside at a "mom- and-pop" farm, but they can get the attention they need at a larger farm where employees aren't as overwhelmed. A new industry also has many needs and can be very disorganized, making it difficult to prioritize research projects.

Species Diversity is Needed A healthy viable industry will require multiple species to cope with market fluctuations, diseases, cash flow, scale of economy and seasonality limitations. Alaska has confined the future of its shellfish industry to indigenous species.
Only two shellfish species indigenous to Alaska are cultured anywhere else in North America: blue mussels and geoduck clams. And, initial interest in geoducks has focused on subtidal culture, of which only a single, rather secretive Canadian company has tried. To compound the problem, very little is known about the lifecycles of indigenous Alaska shellfish unless the species is a major

Years of research generally are required before a new species is ready for commercial development, including hatchery experimentation, growth studies where varying densities of shellfish are grown in different types of gear, nursery trials, holding and processing trials, and market research and development. Sometimes a single stage can prove to be particularly troublesome, requiring years of trial and error. For example, the cementing properties of rock scallops have been vexing growers and researchers in Washington, California and Alaska for decades. While the species grows well in conventional gear, harvest often means destroying the gear or the shellfish.

Regional Differences can be Great in the Greatland What works well in Kachemak Bay may not be duplicated in Southeast because the oceanographic conditions vary so dramatically. The growth rates of Pacific oysters are a good gauge. While there is a great variation from site to site, oysters can be grown to market-size in two growing seasons at many farms in Southeast and Prince William Sound, but it will take 3-4 years in Kachemak Bay. From a growers perspective, the best research gives a good picture of how something might work at his or her

farming operation. This generally means researchers will need to cooperating farmers, and, to date, researchers haven't been very successful in getting farmers to stick to a schedule and carefully follow other project protocol. Regionalization also increases project expense and logistics.

Market R&D is Necessary & Challenging One of the great myths about aquaculture is that it is very market-driven. Many species are developed because they do well in aquaculture settings and markets are developed as production grows. Alaska's problems are compounded by the reality that there are no ready-made markets for the indigenous shellfish currently targeted for aquaculture research. Getting a good grip on market opportunities for a species that isn't in the marketplace can be difficult. Cockles are a good example. Current efforts to test the viability of Alaska cockles are focused upon a steamer clam-sized product, but hardly any cockles are sold in the United States. Cockles also have a very short shelf life, and existing markets for frozen clams are very small.

New Zealand mussel sales took off after a frozen product form was developed and markets were developed that accepted this "new" product form. Alaskan oysters face very parallel challenges in existing markets. Transportation costs for live oysters from Alaska produce an onerous marketing barrier, despite Alaska's quality advantages.

Research Coordination is Needed The potential exists to conduct coordinated research projects from Ketchikan to Kodiak, but there is limited collaboration and very little communication between these programs today. Achieving some kind of linkage among these diverse public, private and university agencies and nonprofit groups will have a large positive impact.

Costs are High in Alaska Almost too obvious to mention, but necessary to include in a list of constraints, is the high cost of doing anything in Alaska that every industry has faced in developing in Alaska. Marine research is no exception. Particularly expensive is anything that takes a project away from a research center. Travel to rural areas is very costly and marine work generally means having to lease a vessel at very high rates.
Creative new methods utilizing communications technology and other new approaches will be needed.

Lack of Best Practices in a Startup Industry As a new industry of shellfish growers is being created in Alaska there is no pool of experienced know how to draw from. Each new business has to invent the wheel. There are no systems to pass on the history of successes or failures in a small fledging industry. There are no apprentice programs, educational programs or manuals that create the foundation of a mature industry. A recent grant request by oyster farmers defined the problem:

"Most oyster farmers are using outdated culture techniques and equipment that contribute to chronic labor problems, extremely poor recovery rates (spat to half shell oyster), reduced product quality and many other inefficiencies, and these bad practices are being passed on to new farming operations.

Technology, management and business practices have yet to be determined that are "Alaska specific". Around the globe is a wealth of technology and experience that can be transferred to Alaska. Some will work, some won't and new variations will have to be adapted to work in Alaska.

Supportive Regulatory Environment The success stories for aquaculture all point to the need to develop a regulatory framework based on solid science that supports industry growth, maturity and development. At the beginning of an industry the science and industry experience does not exist to design new regulations or change existing regulations to fit the needs of a new industry.

Alaska has made significant progress on changing and building a regulatory framework to launch a viable shellfish industry that meets the needs of wild harvest, enhancement and culturing. This process will need to continue as more information, better science and broader industry experience is gained.

Appendix I: Milestones in Alaska Shellfish Aquaculture and Enhancement

Compiled by Raymond RaLonde, University of Alaska aquaculture specialist, this report documents the steady progress Alaska has made in removing the constraints to building a globally competitive Alaska shellfish industry.

Milestone	Year	Impact
Aquatic farm Act	1988	Created a systematic permitting program fish shellfish and seaweed farming. Specified a single lead agency (DNR) responsible for developing a consolidated permit application, receiver of permit applications and coordinator of permit reviews.
Seagrant aquaculture specialist hired	1991	Position was vacant for 5 years
Shellfish hatchery	1992	ADF&G and MAP developed preliminary design for shellfish hatchery
Business of Aquatic Farming Statewide Conference	1992	First shellfish aquaculture conference after a five year lull in activity. Sponsored by Alaska Sea Grant
ASGA shellfish marketing program	1993-5	The program was affective in educating seafood buyers and restaurants in Alaska. The program firmly established Alaskan grown oysters in preference to oyster farmed outside of the state.
Shellfish Development Plan for Kachemak Bay	1993	Defined and constraints to shellfish aquaculture development, action plan, and preliminary planning of the Kachemak Shellfish Mariculture Association Cooperative.
Floating Upwelling Nursery Project, completion of first pilot study	1994	Won the EDA award for innovation for this project. Publication was completed and distributed world wide
Broadening Alaska' Shellfish Farming Opportunities Conference	1995	This conference established for the first time a serious inquiry into farming of indigenous on-bottom species and the regulatory process needed to enable it to happen
PSP the Alaska Program conference and publication	1996	Regulatory process and testing for PSP is a logistical and financial burden for Alaskan shellfish farmers. This conference helped in modifying testing requirements do the public health remains protected but with much less burden for farmers
Floating Upwelling Nursery Project, completion of production size design study	1997	Oyster nursery now owned and operated by the Kachemak Shellfish Mariculture Association
Shellfish hatchery completed discussion	1997	This milestone was essential to securing the supply of Alaskan oyster seed and enabling seed production of indigenous species not yet cultivated

Milestone	Year	Impact
KSMA cooperative officially incorporated	1998	Kachemak Shellfish Mariculture Cooperative is composed of approximately 17 farms and is a model for future cooperative developments
Research commences of Jellett test kit for PSP	1998	The Jellett test kit stared development. Seven years of research finally lead to its conditional approval for PSP testing in Alaska. The test cost $20.00 and takes 20 minutes to complete testing of a sample while laboratory testing costs $125.00 and results take at least 24 hours.
Development of molluscan broodstock program growout site in Prince William Sound	1998	The USDA Molluscan Broodstock Program in centered in Hatfield Marine Laboratory in Newport, Oregon. The program has been in operation for a number of years, but Alaska did not have a growout site to develop an Alaskan strain. ASTF funds were acquired to construct a growout site in Prince William Sound and remains in operation. The third iteration of the seed production is now in progress. So far approximately a 20% increase in growth has been achieved and these broodlines are now used for hatchery seed production.
Development of hatchery techniques for production of purple hinge rock scallop completed	1999	Species diversification is a high priority for the Alaskan shellfish industry and purple hinge rock scallop is the only scallop on the West Coast that is feasible for farming. Since it has never been culture before, hatchery seed production research was necessary. Through a grant from the Alaska Science and Technology Foundation, seed production techniques were developed.
Completion of "Bivalve inventories and native littleneck clam (Protothaca staminea) culture studies – By Dr, Kenneth Brooks	2001	Established inventory protocols and techniques to farm littleneck clams in southcentral Alaska
Intertidal geoduck aquaculture research begins	2001	Began in two locations in southeastern Alaska, Sitka Sound and Annette Island. Geoducks are normally subtidal, but intertidal culture is practices in Washington and British Columbia. The pilot projects are showing that intertidal culture is feasible and growth rates nearly comparable to Washington.
Completion and ASGA approval of their shellfish aquaculture Environmental Codes of Practice	2001	The Alaskan Shellfish Growers Association developed an Environmental Codes of Practice to address environmental concerns about Shellfish Farming. The project was funded by the Alaskan Environmental Alliance.

Milestone	Year	Impact
Changes in DEC testing requirements for geoduck clams	2002	PSP found only in the visceral mass of geoduck clams reduces their market price from over $5.00 to less than $1.00 per pound when the live clams are killed and the visceral mass removed before they are sold. Through a workshop process, experts from around the United States participated in modifying the regulations so the public health remains secure, but also allowing harvest and sale of high valued live clams.
Completion of "Littleneck Clam" farm development in Alaska - by Raymond RaLonde	2003	Established inventory protocols and techniques to farm littleneck clams in southeast Alaska
Successful completion of SBIR research project for hatchery production of basket cockle seed	2003	Species diversification is a high priority for the Alaskan shellfish industry and the basket cockle is the state's fastest growing shellfish. Since it has never been culture before, hatchery seed production research was necessary. Through a grant from the Small Business Intentiver Research Program, seed production techniques were developed.
Completion of Eagle Shellfish Farm and Naukati shellfish nurseries	2003 2004	These large production hatcheries can provide millions of shellfish to seed to southeast and south-central Alaska
House Bill 208 and pre-authorization of aquatic farm leases completed	2004	Because of this project, 1,456 acres of aquatic farm leases were pre-authorized for development. Rather that applying only during the spring in odd number years, farm applicants can apply for one of the HB 208 sites, fill out a five page application and submit a farm development plan and have a farm site in a few weeks.
State funded $858,000 for shellfish aquaculture development projects	2004	Projects ranging from shellfish nurseries, storage and retail facilities, and improvements to the hatchery were funded.
Farmer friendly regulatory reform completed and approved by ADF&G and industry	2005	Shellfish regulations needed substantial reform in order to attract and retain shellfish farmers. These reforms vastly improved the permit review, compliance, and reported requirement for shellfish farmers
FDA authorization of the Jellett test kit for screening	2005	This conditional approval was authorized by FDA for screen of shellfish
Four year growout study for purple hinge rock scallop completed	2005	
One million dollar grant to KSMA for construction of shellfish holding and retail facility	2006	The Kachemak Shellfish Mariculture Cooperative will be constructing a large storage, shipping, and retail facility in Homer Alaska.

Appendix J: Geoduck Farming and Enhancement in British Columbia and Washington State

British Columbia Geoduck Farming and Enhancement

British Columbia currently harvests four million pounds of geoduck annually and that results in a $40 million wholesale value. The harvest and industry are fully mature and have reached a plateau of stability and sustainability for a wild harvest. Any future growth will come from enhancement or culturing of geoduck.

Enhancement, or re-seeding, of geoducks was initiated in British Columbia by the

Underwater Harvesters' Association (UHA). The objective of UHA's enhancement program is to plant enough seed each year to replace half the annual harvested quota. UHA has had varied success with enhancement, mostly hinged upon seed production from a hatchery source.

Since 1997 the UHA has planted between 250,000 and 700,000 seed each year. Their target is one million per year to reach the goal of replacing half the annual commercial harvest.

One project that UHA has successfully funded has been research and development to build a seeding machine capable of mechanically planting seed on a commercial scale.

The national government office of the Commissioner for Aquaculture Development prepared an exhaustive report in 2001, "Economic Potential of Sea Ranching and Enhancement of Selected Shellfish Species in Canada." The report defined in detail the significant potential for expansion of the geoduck clam harvest to $250 million through enhancement. One of the important findings in this report was the need for investment in research and development. "A considerable investment in research and development is needed in order to bring the vision of a wide-scale culture-based fishery in Canada to fruition. Success elsewhere is the best indicator that the vision is achievable."

The recommended research and development strategy has taken a significant step forward with the establishment of the Centre for Shellfish Research in Nanaimo, British Columbia. The Centre is driven by an industry developed list of R&D needs.

Washington State Geoduck Farming and Enhancement

Washington harvests four million pounds of geoducks annually through its capture fishery with a wholesale value of $35 million. The state's aquaculture industry instigated the development of the culture of geoduck approximately twenty years ago. Cultured production of geoduck has expanded rapidly in recent years with an additional harvest of 850,000 pounds recorded in 2005 that now accounts for one fifth of Washington total harvest.

Geoduck aquaculture was first pursued by the Washington Department of Fisheries and Natural Resources in the late 1970s at Point Whitney Shellfish Hatchery with the intent to enhance the subtidal commercial harvest and double the harvest within 10 years. First enhancement outplanting trials were disastrous with low survival rates due to the high level of predation when no predator protection was given to outplanted seed. By 1987, the Point Whitney Shellfish Hatchery was producing 6 million seen annually, but planted without predator protection in subtidal areas. It wasn't until the mid 1990s that predator protection was initiated and success was finally achieved in both intertidal and subtidal aquaculture.

While several companies pioneered the geoduck culture industry in Washington, the industry has begun to grow rapidly in recent years as beach front landowners have realized there is economic potential in their "front yard." Leasing of tidelands by private land owners for the purpose of geoduck and other shellfish culture is fueling industry growth. Several large companies with accumulated expertise in culturing shellfish are leading the industry growth. One company is now reportedly harvesting 20,000 pounds per week.

The access to private tidelands has been an important factor in the success, growth and sustainability of shellfish aquaculture of all species in Washington.

Washington shellfish growers annually harvest 88 million pounds of all species with a harvest value of $97 million in 2005. Oysters constitute the largest component of the industry with 75% of the value of the industry. The growth in geoduck volume is providing a significant source of diversification in value. The parallels with Washington geoduck culture and greenlip mussel culture in New Zealand are very striking.

Research and development in Washington is supported by several entities, most importantly the Pacific Shellfish Institute (PSI) which was organized in 1995 to develop and disseminate scientific and technical information of value to the general public, shellfish farmers, and public officials. The sixteen member Board is made up of shellfish growers, researchers, educators and government agency specialists.

Through a lengthy process, PSI has developed the "2010 Goals: Research and Initiative Priorities" that define research needs of the industry. A prioritization process was included to rate each of the specific 126 recommendations. Nine broad areas spanning industry needs and challenges were covered from new species, ecology, training to marketing.

Sources: British Columbia Ministry of Agriculture and Lands (2005). The 2004 British Columbia Seafood Industry Year in Review,from http://www.agf.gov.bc.ca/fisheries/Shellfish/shellfish.main.htm

British Columbia Shellfish Growers Association (2006). Geoduck, from
http://www.bcsga.ca/encyclopedia/41.php.

Pacific Coast Shellfish Growers Association (2006). Shellfish Production on the West Coast, from
http://www.pcsga.org/

Appendix K: Shellfish Industry: Mission, Priorities and Communications

*Planning Session Outcomes, January 9 & 10, 2006**

Shellfish Industry Mission

Create a collaborative environment for shellfish growers to have the opportunity and capacity to operate profitable businesses.

Key Areas of Emphasis

1. Identify sources of funding and fund infrastructure needs.
2. Ensure continued operations of a hatchery through funding and development of the hatchery strategic long-term goals and objectives
3. Explore the creation of and access to state and federally led funding programs to support the start-up and expansion of individual business endeavors
   - Establish a mariculture development program
   - Seek the Governors support in creating within the Department of Economic Development a lead person or department that guide and promote the mariculture industry.
   - Establish an industry advisory group.
   - Develop systems to encourage a more business friendly permitting and licensing process and cooperative focus
4. Assist with species diversification efforts

Identify new and/or alternative species, test how to spawn and grow-out species, identify and test harvest equipment, explore value added product development

* The State of Alaska hosted a meeting of Alaska shellfish industry professionals and leaders in Anchorage, January, 2006, to analyze the industry's strengths, weaknesses, opportunities, threats, and competitive environment. At that meeting industry professionals and leaders established a mission for the industry, reviewed common goals and objectives, and established a future vision. This is a summary of their conclusions.