

## Downeast Institute and Technology Transfer

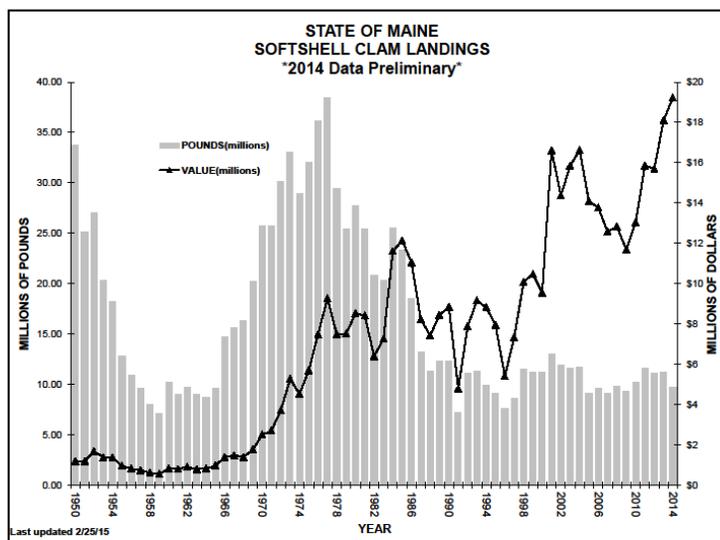
According to the USDA, 1.4 billion pounds of seafood will be required by 2020 to maintain current US per capita consumption. 85% of seafood consumed in the US is imported, raising questions about food safety and security, and contributing to a \$10.4 billion trade deficit in 2010. The need and opportunity to expand and diversify Maine's aquaculture industry is more pronounced than ever. The Maine Aquaculture Association (MAA) has developed a plan for growing this sector in Maine. MAA identifies the need for geographically dispersed research and development centers "that have the physical capacity to do research on species and production methods at scales relevant to Maine." The need for training for entrepreneurs was also identified. MAA reports that about 80% of the requests for new aquaculture leases have come from traditional fishing families, (Directing the Future of Maine's Aquaculture Cluster; an Economic Development Plan, 2015). Using selective breeding to increase disease resistance, reproduction and meat yield, and developing plant-based proteins were specific opportunities for growth in Maine's aquaculture industry identified by the Maine Technology Institute (MTI/Battelle, 2014).

DEI fits into these plans by supporting the farming of shellfish, which can be entered for a relatively small investment, has a low visual impact, and since shellfish are siphon feeders, requires no artificial food sources for the growing animals.

### *Soft-Shell Clams*

Harvest levels of soft-shell clams remain low but relatively stable. The gap on this graph between landings and price demonstrates one of the effects of supply and demand, which is an upward price trend. This upward pressure on price justifies intensive community management of soft-shell clam resources, and encourages entry into the emerging area of clam farming.

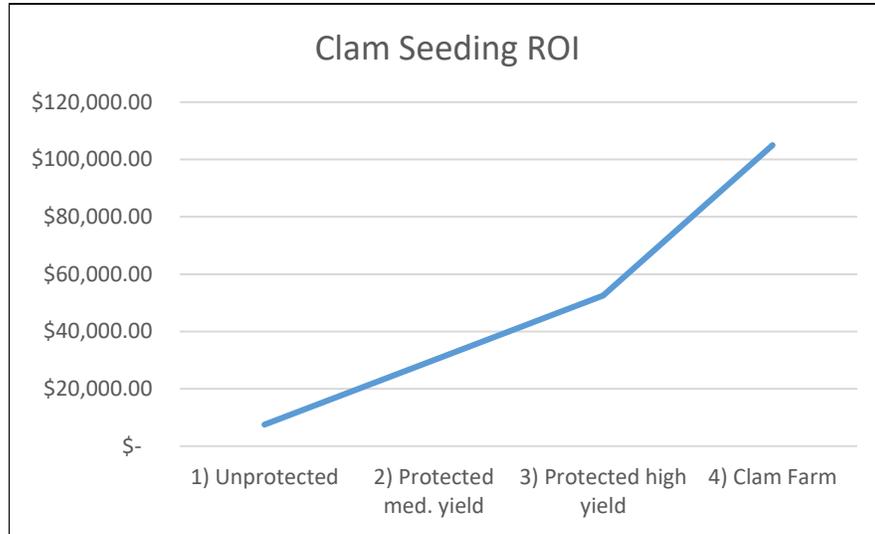
DEI's research since 1987 has perfected the process of spawning adult soft-shell clams and rearing juveniles. We have produced hundreds of millions of seed clams used to enhance natural clam populations on municipal flats in more than 70 of Maine's coastal towns and beyond. Our



current research on optimizing methods for protecting clam flats from green crabs and other predators has provided a blueprint for clam farming in Maine, currently being considered by the coastal communities of Harpswell, Brunswick, and Freeport. Our recent (2012-present) field studies in Cumberland County have coincided with legislation passed in 2015 making intertidal clam farms feasible.

Determining return on investment of public stock enhancement efforts can be difficult because there are many variables: survival, which is affected by how well clam seed is naturally or manually protected from predators and other natural challenges, the size of the seed broadcast onto the flats, local enforcement, and the price per bushel of clams.

As a comparative example, illustrated in this chart, it would cost \$25,650 per year to buy 1 million seed clams greater than 8mm (the size most towns request) and protective netting<sup>1</sup>. 1) Unprotected or poorly protected clams could have a low survival rate and that, combined



with a low price, would result in a loss. 2) Protected flats with a conservative 40% survival rate, achievable through the application of predator netting, and a conservative price of \$90 per bushel (\$10 lower than the 2015 state average) would realize a landings value of \$30,000. 3) If a protected flat realized a 70% survival rate at the same price, the resulting landed value would be \$52,500. 4) The individual or community actually engaged in clam farming, whereby predator nets are placed and monitored, and harvest takes place at the optimal price level, could have landed \$105,000 or more in 2015 with this same investment.

From 2009 to 2015, DEI has supplied 7,895,000 soft-shell clams to Maine communities and growers for purposes other than research. While we always recommend protecting seed, some towns do not. Many towns do, and our field experiments show in these cases survival can be as high as 90%. Based on the example above, we estimate DEI's economic impact ranged from \$237,000 to \$829,000 for clams seed sold during that period.

The first clam farm in Maine was begun in 2014 by clammer Chris Warner of Georgetown. His project is currently being supported through funding and research from Manomet as a sustainable economies project. He estimates when he begins harvesting in 2016, his \$10,000 investment will yield \$50,000.

The "seed" of this clam farm started with DEI's Community Clam Culture program developed in 1997 and continuing to 1999 in the coastal communities of Edmunds/Trescott, Wiscasset, and Georgetown. Those communities received approximately 1 million seed clams in each of two

<sup>1</sup> Cost is \$25/1000 8mm clams, \$5,200 in protective netting amortized over its useful life of 8 years. Netting amount is determined by seeding density. For this example, we allowed for a generous amount of netting to account for damage or loss.

successive years. Field projects with schools, teachers, and clammers in each community were developed, and there continues to be coordinated efforts with these same communities today. Chris Warner was a high school student who participated in the Community Clam Culture program, and he tested the techniques he had learned through that effort for over a decade, placing seed clams and nets in areas that were subproductive, and continued to see success. DEI is still involved in his emerging farm, supplying seed and technology transfer as this concept is finally being commercialized. In 2015, Manomet received a grant from the NOAA Saltonstall-Kennedy program to expand commercial clam farming, and they expect to develop five more clam farms along the coast. DEI and Dr. Beal will be assisting Manomet in this effort, and as the only clam hatchery in Maine, DEI will be called upon to supply the clam seed.

Finally, every seeded flat serves as a nursery for the wild clam harvest, since surviving clams will spawn at least twice before growing to legal size. This may be a factor in the relative stability of Maine clam yields since DEI/BIRSH began seeding flats, but that would be difficult to prove.

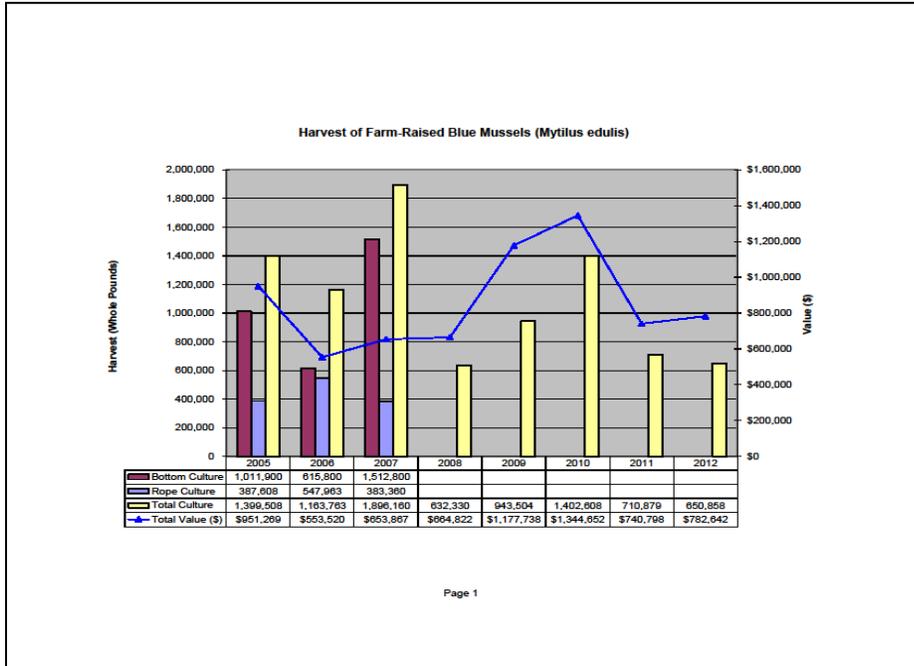
### *Hard Clams*

In the first-ever lease of this type in eastern Maine, DEI helped an individual shellfish farmer from 2008-2010 to examine seasonal growth and survival of cultured hard clam seed at multiple sites from Trenton east to Cobscook Bay. DEI helped the farmer to secure a Phase I Small Business Innovative Research (SBIR) grant through the USDA for \$90,000, and a year later, a 2-year, Phase II SBIR for \$400,000. The initial research revealed an ideal growout site in Goose Cove, Trenton, which realized >85% survival. Further study determined the configuration of a field-based nursery system, optimum nursery and storage techniques, and factors affecting growth to marketable size, all conducted on an experimental lease in Goose Cove. DEI assisted in that applied research as well. The company has not yet reached full scale commercialization, but recently raised about 500,000 clams on their experimental lease, at a value of approximately \$229,000. They applied for a 13-acre commercial lease in late 2014.

DEI also is leading research into new or emerging shellfish species suitable for farming, and new hatchery candidates:

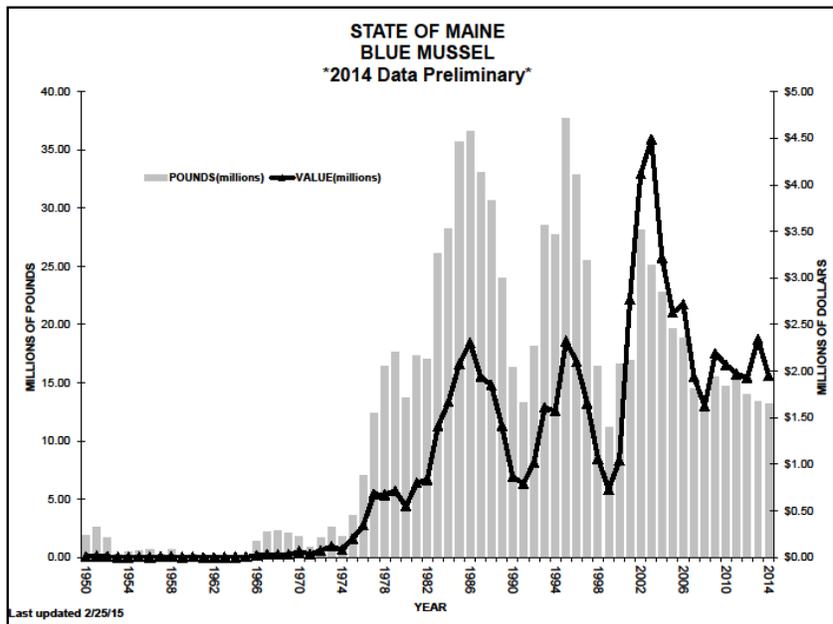
## Blue Mussels

Maine's blue mussels are harvested from the wild and grown in lease sites. Farmers and fishermen produced a combined total of 16.1 million lbs in 2012, a fraction of those produced in Prince Edward Island - nearly 50.7 million lbs in 2013 with a landed value of \$28.6 million. The



two graphs below show a decline both in wild and farmed landings of blue mussels in Maine. A large mussel company that ceased operations accounts for the precipitous drop of farm-raised mussels in 2008.

The consistency with which wild mussel larvae naturally settle onto growing media placed in the water column remains a source of risk for growers. Thanks to a recent research grant from the National Science Foundation, DEI has developed culture methods to provide growers with a reliable source of mussel "seed" and juvenile mussels, which will allow them to expand their businesses to meet market demands for mussels year round.



them to reliably serve and expand their markets. In addition, our selective breeding program is

expected to decrease the amount of time it takes a juvenile mussel to reach market size, and open opportunities in mussel aquaculture in Washington County and beyond.

In 2016, DEI will be working with Jonesport-based Moosabec Mussels, to help the company isolate the best methods and media for growing wild mussels on their existing lease site, and will compare results with DEI's pre-seeded ropes. That effort began when Moosabec Mussels asked DEI staff to assist them with a Seed Grant proposal to the Maine Technology Institute. The Seed Grant for \$25,000 was recently approved by MTI's Aquaculture Committee, and the work will occur over the next nine months.

### *Arctic Surfclams*

DEI is the only marine research facility in the world to have successfully spawned adults, reared larvae and juvenile Arctic surfclams, and grow these juveniles to adulthood. A high value species that is prized for its large and bright red foot used in sushi and sashimi, adult Arctic surfclams are a \$50 million fishery in Canada. DEI, in partnership with UMM, has discovered methods to produce a small, whole Arctic surfclam that will become a new species for aquaculture in Maine. Our current research activities are examining environmental and biological factors that will allow farmers to use our cultured surfclam juveniles for field-based grow out operations. We have consistent success in spawning adults and rearing the juveniles, and this year will be testing growout techniques to be used by future shellfish farmers. Unlike other shellfish species, Arctic surfclams thrive in cold water and are ideal for growing out along Washington County's coast. An initial Market Assessment conducted by natural resource economist Kevin Athern of UMM indicates there would be adequate demand for the product. In addition, a local distributor of shellfish products is prepared to use his retail and wholesale customers to get the Arctic surfclams to market.

Field trials initiated in 2016 show early promise, with 300% growth in juveniles over a 2 month period at a site tested in Trenton.

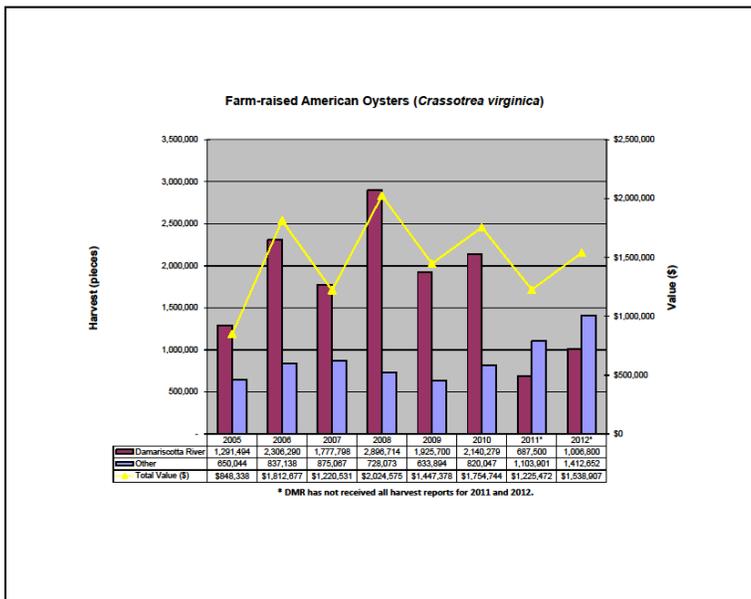
### *Razor Clams*

Considered a delicacy by many, razor clams have a very limited market because there is such a limited supply. They are only accessible at the lowest of low tides, and no formal commercial fishery exists for them in Maine at this time. Fourth graders attending a summer camp at DEI discovered some adult razor clams and brought them into the hatchery. Research technicians agreed to keep them and try to spawn and grow them out "for fun." That exercise was successful, and presently, we are the only marine lab/shellfish hatchery in Maine that has achieved rearing several million razor clam juveniles. This success is exciting, and we will be looking to repeat our efforts in 2016 working with the Town of Waldoboro to enhance their public stocks of razor clams, and examining the potential of developing methods to farm razor clams.

### *European Oysters*

Maine's American oyster industry comprises the majority of cultured shellfish in Maine.

Landings, shown in this graph, are from farms located east of Ellsworth.



European Oysters, (*Ostrea edulis*), sought after by many because of their unique flavor, have been harvested in Europe for centuries. Overfishing and depletion motivated a variety of spat collection practices, but ultimately, diseases affecting traditional growing areas in the 1970s and 1980s have kept European production at a very low level. Research in Europe to develop strains of European oysters that are disease-resistant have met with limited success. European oysters were introduced to Maine in 1949, and have been found in limited quantities in eastern Maine. In

2008, DEI successfully spawned and raised juvenile European oysters that were grown out and sold in Maine. DEI's limited laboratory space prevented continuation of this important applied research and development effort. No hatcheries for European oysters exist at this time. Unlike American oysters, European oysters grow well in cold waters, and are amenable to farming in Washington County. Together with Arctic surfclams, our efforts with European oysters have great scope for providing new economic opportunities for shellfish farmers in eastern Maine.

Piloting and demonstrating a process for consistent success of European oyster culture will allow DEI to ensure a supply of European oyster seed to growers, which will enhance opportunities for new and existing shellfish farmers. Reliable access to European oyster seed allows existing

	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10	TOTAL
<b>VALUE</b>											
Arctic surfclams					\$ 75,000	\$ 150,000	\$ 225,000	\$ 300,000	\$ 600,000	\$ 750,000	\$ 2,100,000
blue mussels				\$ 50,000	\$ 50,000	\$ 100,000	\$ 200,000	\$ 300,000	\$ 500,000	\$ 700,000	\$ 1,900,000
European oysters						\$ 192,000	\$ 384,000	\$ 768,000	\$ 1,920,000	\$ 3,840,000	\$ 7,104,000
soft-shell clams			\$ 50,000	\$ 50,000	\$ 100,000	\$ 100,000	\$ 200,000	\$ 200,000	\$ 200,000	\$ 300,000	\$ 1,100,000
<b>TOTAL</b>			\$ 50,000	\$ 100,000	\$ 225,000	\$ 542,000	\$ 909,000	\$ 1,568,000	\$ 3,220,000	\$ 5,590,000	\$ 12,204,000
<b>LANDINGS (lbs)</b>											
Arctic surfclams					50,000	100,000	150,000	200,000	400,000	500,000	1,400,000
blue mussels				50,000	50,000	100,000	200,000	300,000	500,000	700,000	1,900,000
European oysters						50,000	100,000	200,000	500,000	1,000,000	1,850,000
soft-shell clams			25,000	25,000	50,000	50,000	50,000	100,000	100,000	150,000	550,000
<b>TOTAL</b>			25,000	75,000	150,000	300,000	500,000	800,000	1,500,000	2,350,000	5,700,000

oyster farmers to diversify their product line and expand their markets, potentially to Europe. Finally, if demand for European oyster seed reaches a suitable volume, it represents a new product line for existing or new hatcheries.