Maine Farmed Shellfish Market Analysis

RESEARCH BY:

THE HALE GROUP, LTD.
DANVERS, MA

IN PARTNERSHIP WITH

THE GULF OF MAINE
RESEARCH INSTITUTE

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Gulf of Maine
Research Institute
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LIST OF ACRONYMS AND TERMS

ACCSP = Atlantic Coastal Cooperative Statistics Program
Bottom Culture = Culture technique where mussels are grown directly on the seabed
Dayboat Scallop = Wild-caught scallops that were harvested in Maine state waters and landed within a 24-hour period.
DMR = Maine Department of Marine Resources
ECSGA = East Coast Shellfish Growers Association
Farmed = Grown on a marine aquaculture farm
Gulf = Gulf of Mexico
MAA = The Maine Aquaculture Association
Mussel = Blue mussel *(Mytilus edulis)* unless noted otherwise.
NMFS = National Marine Fisheries Service
Oyster = Eastern oyster *(Crassostrea virginica)* unless noted otherwise.
Half shell oyster = Live oyster that has been shucked for raw consumption.
Planning Horizon = 15-year timeline of this analysis, from 2015 – 2030.
Rope Grown = Culture technique where mussels are grown on ropes that are suspended in the water column.
Scallop = Sea scallop *(Placopecten magellanicus)* unless noted otherwise.
Shucked oyster = Oyster meat that has been removed from the shell.
Spat on Shell = Culture technique where several baby oysters (called spat) are grown on an old oyster shell resulting in a clump of several oysters.
THG = The Hale Group
Whole oyster = Live oyster in its shell.
Wild = Caught in a wild fishery.

ACKNOWLEDGEMENTS

The Maine Farmed Shellfish Market Analysis was a true team effort that would not have been possible without help from the following organizations and individuals.

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We thank The Hale Group for its high-quality research and analysis, strategic insight, and responsiveness to GMRI and industry advisory committee feedback.

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INTRODUCTION

i. Purpose of Study

There is great enthusiasm for expanding aquaculture in Maine as an economic opportunity for coastal communities. Yet very little is known about existing and potential markets for the products, particularly farmed shellfish, that a growing industry would produce. GMRI embarked on this project to produce a data-driven, quantitative market assessment that informs industry leaders and business owners about the potential scale and scope of markets for farmed shellfish and to facilitate strategic growth in the industry.

ii. Scope of Work

This report provides The Hale Group's market opportunity analysis for Maine farmed shellfish, with oversight from GMRI and the industry advisory committee.

This initiative had the following objectives:

1. Conduct a comprehensive market analysis of the shellfish aquaculture industry, including supply and demand elements for Eastern oysters (*Crassostrea virginica*), blue mussels (*Mytilus edulis*) and sea scallops (*Placopecten magellanicus*), with particular emphasis on the implications for Maine's aquaculture industry.

2. Evaluate the scale and scope of the opportunity for Maine's aquaculture industry participants.

3. Recommend strategies that will enable Maine to build its aquaculture industry while reducing internal Maine competition.

4. Incorporate a planning horizon of 15 years, until 2030, to provide long-range context to support capital investment decisions while balancing the diminished accuracy of data projections and research insights beyond 10 – 15 years.

EXECUTIVE SUMMARY

i. Overview

Maine is uniquely positioned to leverage and expand its aquaculture industry to capture a greater share of the shellfish marketplace for oysters, mussels and scallops. Maine's competitive advantages include:

- High quality products,
- Available space for aquaculture expansion,
- Strong consumer brand affinity to Maine products,
- Strategic location near distribution centers,
- Proximity to large population centers with high shellfish consumption (the Northeast region consumes approximately 20% of all U.S. shellfish), and
- Experience with, and commitment to, best aquaculture practices.

In 2015, the landed value of oysters, mussels, and scallops in the U.S. was roughly $700 million. Maine accounted for approximately 4% of that total, delivering $24 million to harvesters. Of the Maine cultured shellfish total, aquaculture accounted for 25%, producing a landed value of approximately $6.5 million. The Hale Group conducted a preliminary total economic benefit analysis (incorporating supply chain value add and economic multiplier) to the $6.5 million landed value and estimated that Maine's existing shellfish aquaculture industry may generate a total economic benefit of over $15 million.

Maine's current farmed shellfish capacity, at approximately 600 leased acres with another 75+ acres in the lease application process, is not sufficient to meet the projected demand over the planning horizon. Based on current farmed shellfish yields per acre, the Maine shellfish aquaculture industry will need to add an additional 550–600 acres of capacity by 2030. Oyster production would represent roughly 480 of those new acres, while mussel production would account for 90 additional acres if new farms use rope cultivation techniques (Table 1). This equates to an average of 35–40 total new acres annually through 2030, including current lease applications.

Based on growth requirements to meet the projected demand outlined in this report, farmed oysters and mussels would likely utilize 0.1% of Maine's state waters by 2030 (Figure 1). Even if the majority of the incremental mussel acreage utilizes uses the more space-intensive bottom culture technique, the projected acreage requirement is no more than 0.3%.

Table 1. New acreage requirements to meet projected shellfish growth.

	Current		Projected 2030		
	Volume (000)	Lease Acres	Volume (000)	Best Est. Acres [1]	High Est. Acres [2]
Mussels	1,350 lbs.	315	10,500 lbs.	405	2,815
Oysters	7,104 pc.	293	18,629 pc.	770	770
Total		608		1,175	3,585
% ME Shore Line Utilization		**0.06%**	→	**0.1%**	**0.3%**

[1] Best estimate scenario: Assumes incremental Mussel capacity is primarily Rope Grown technique at 100,000 lbs. per acre (3 rafts at 30,000+ lbs. per raft)
[2] At current Mussel yield average of 3,650 lbs. / acre (approximately 60% Bottom Culture)

Source: The Hale Group research, Maine DMR

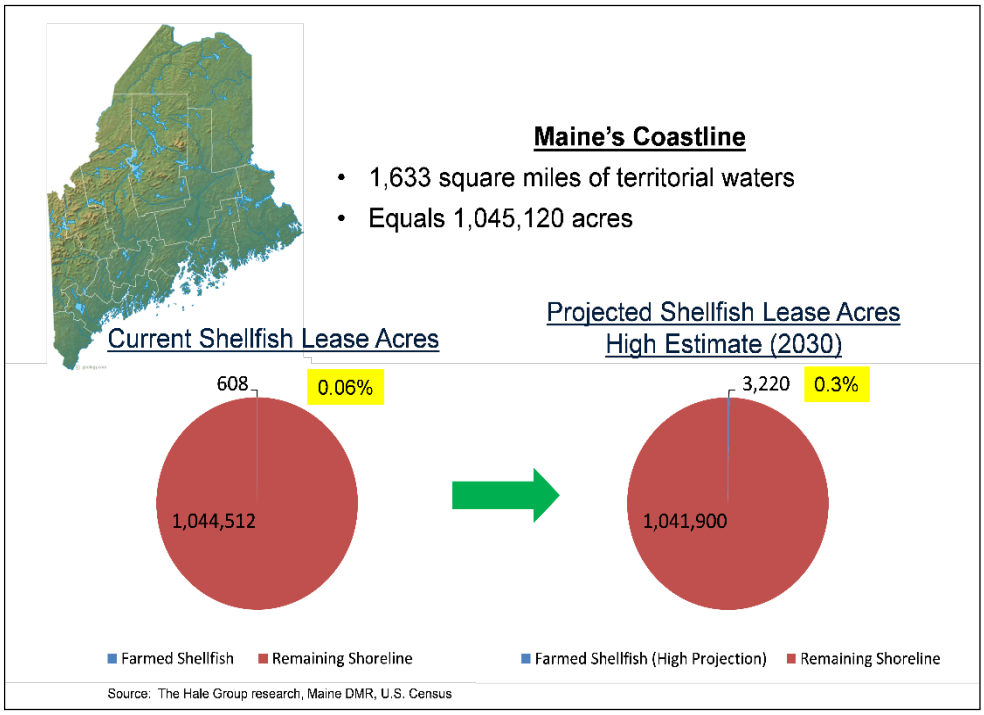


Figure 1. Current and projected new acreage requirements to meet projected shellfish growth.

In order to capitalize on the opportunity, Maine's aquaculture industry will need to evaluate and prioritize its opportunities, determine how best to leverage the Maine brand's strong consumer appeal to create demand, and identify where and how it wishes to compete to build its market presence.

ii. Eastern Oyster Summary

Maine is positioned to be a growth leader in farmed oyster production, but needs to plan for long-term price moderations as supply increases over the next 3–5 years. Currently, Maine oysters command a price premium due to the high-quality perception of cold water oysters. To realize its full potential, the sector will need to employ the following strategies to moderate price declines:

- Build brand equity to help differentiate Maine oysters from the rest of the supply in order to justify a price premium
- Pursue operational efficiencies
- Expand distribution networks
- Invest in winter harvesting capabilities.

The vast majority of U.S. oysters are sourced via aquaculture (~95%). Approximately 900 million oysters are consumed annually in the U.S., of which approximately 60% are whole (consumed in half-shell format) and 40% are shucked. The overall U.S. oyster supply has experienced erratic growth performance in recent years as strong capacity in the Northeast and Mid-Atlantic have been offset by declines in the Gulf of Mexico and Southeast regions. Consensus is that consumer demand remains greater than supply, so positive growth trends are expected to continue in regions with capacity — particularly along the Eastern Seaboard from Virginia to Maine.

There is significant variability in the value of oyster harvest by region. The Northeast commands the highest relative premium among U.S. Regions, driven by the perceived higher quality of their oysters, which are sold primarily in the whole format. Maine accounted for approximately 14% (7.1 MM) of the Northeast's total oyster supply in 2015. Within the Northeast, Maine harvesters receive a premium for their oysters with the Hale Group estimating an average price of $0.58 per oyster. Only Rhode Island growers, by selling their oysters through the Ocean State Shellfish Cooperative, receive a higher average price ($0.68/piece).

Many Maine oyster farmers report a drop-off in demand in late-fall, when orders decrease significantly or stop altogether. Research uncovered that the "Fall Drop Off" is a local, rather than national, phenomenon. Local demand declines when the summer Maine tourist season ends, and Northeast supply increases as some growers bring inventory to market in advance of the winter ice-over. National consumer demand for oysters mirrors restaurant seasonality cycles. Low demand periods (still within 10% of average sales) occur in January and February, with another small decline in September due to the "back-to-school" season.

These dynamics underscore the need for Maine's oyster farmers to expand distribution networks to the major metropolitan areas in the Northeast and beyond. Portland is within 500 miles of four of the Top 10 metropolitan areas (Boston, New York, Philadelphia, & Baltimore/Washington) in the U.S.; within 1,000 miles of six of the Top 10 (+Chicago & Atlanta); within 2,000 miles of eleven of the top 20 (+Detroit, Orlando, Tampa, Minnesota, Denver); within 300 miles of Montreal; and 700 miles of Toronto Canada. All of these markets have significant numbers of restaurants that serve shellfish.

Maine is projected to be a growth leader in oyster supply, driven by increased capacity and continued demand for high-quality, cold water whole oysters. Best estimates find that Maine capacity will almost triple over the 15-year planning horizon, generating an incremental 10+ million oysters. Pricing for Maine oysters will moderate as supply grows — mirroring projected nationwide trends as total U.S. supply grows — but is predicted to remain relatively high. Maine's reliance on whole (half-shell) formats should provide some insulation from the anticipated growth in lower cost Gulf and Mid-Atlantic oysters, but the sector must plan for this scenario over the next decade.

iii. Blue Mussel Summary

Maine is positioned to be a growth leader in farmed mussel production, given its available capacity for growth, high quality growing environment, brand equity (cited repeatedly by supply chain participants across the country during the research), and opportunity to displace Canadian product in close-proximity markets.

Live mussels are an approximately $70 million ex-vessel value industry in the U.S. The U.S. live mussel marketplace is sourced primarily from the Northeast (37%), the Pacific Northwest (20%) and Canada (43%). Maine and Massachusetts are the major Northeast producers. Research indicates that aquaculture accounts for approximately 15% of the U.S. supply and the majority of the Canadian supply. The Hale Group research indicates that aquaculture accounts for approximately 9% of Maine's volume (1.35MM lbs.).

The U.S. live mussel supply, including Canadian imports, has grown at approximately a +4% annual rate since the 2008 recession, driven largely by Massachusetts, who made additional wild volume available in 2015. Canadian supply has increased moderately, although Canadian mussel exports to the U.S. have declined in recent years due to the harsh 2014-2015 winter. Maine's mussel supply has remained relatively stable in recent years after a decline in the early 2000s.

Farmed mussels command a price premium in the marketplace, driven by their higher meat content and perceived higher quality (cleaner, better shell structure, etc.). Within Maine aquaculture, mussels are cultured using rope-grown or bottom culture techniques. Rope grown command the highest price ($2.10/lb) compared to bottom culture ($1.55/lb) or wild ($0.90/lb).

Given its close proximity to New England, PEI mussels are a significant competitor for Maine mussels, and have been viewed as the standard for a long time. Canadian mussels are distributed across the U.S. with penetration highest in the northern half of the country. Over-crowding in PEI mussel areas as well as growing recognition of Northeast mussels' quality, have diminished PEI's quality perception and image among some customers — although PEI mussels remain the industry standard for many. The estimated 9-million pounds of PEI mussels consumed annually in the Northeast and Mid-Atlantic represent an opportunity for Maine mussels to further penetrate close proximity market.

Wholesalers and foodservice operators report minimal seasonality with mussel demand or supply. Seasonality in Maine is tied to the ability of a sea farmers to access their product in

winter, rather than a demand-driven issue. In general, consumer demand is at its peak during the summer months and holidays.

The total live mussel marketplace is projected to continue to expand at a modest pace, with moderate growth from imports, and is expected to approach 80 million whole pounds by the end of the planning horizon. Northeast mussels, including Maine, are projected to grow faster than the industry average given their high quality perception and expected capacity increases.

Overall mussel demand is projected to continue to grow modestly over the planning horizon. While overall species growth may be moderate, buyers believe that there is significant growth potential for high quality, premium mussels. Supply and demand projections indicate that total U.S. mussel supply will marginally outpace demand over the planning horizon, with farmed mussels accounting for almost 90% of the 16 million pound projected total growth, and Maine accounting for more than ½ of the farmed mussel volume growth. Over the planning horizon, it is projected that the Northeast farmed mussels will capture approximately 20 share points from Canada and the Pac NW.

Seizing on the opportunity to capture Canadian market share will require Maine's mussel farmers to:

- Ensure consistency of supply from Maine
- Define the value proposition and branding strategy, as Maine harvesters will be competing against a well-entrenched competitor
- Consider the potential impact of exchange rate and subsidy levels on pricing.

Growth projections estimate that Maine's farmed mussel industry will grow approximately six-fold over the planning horizon, from 1.35MM in 2015 to 10.5MM in 2030, delivering approximately $20 million in landed value to the state. During this time, the overall market is expected to expand modestly, while wild supply is constrained, and Maine farmed mussels compete with PEI for market share. Pricing is estimated to moderate by approximately -10% by 2030 under this scenario.

iv. Sea Scallop Summary

Maine is particularly well-suited for scallop aquaculture growth, given the significant room for new sites and existing perception that Maine's wild scallops are high quality. Achieving sufficient scale will require Maine to invest in development of scallop aquaculture capabilities.

The total U.S. scallop marketplace is estimated to be approximately 250 million whole pounds and 30 million meat pounds, with a landed value of approximately $380 million. In the U.S., the majority of scallops are sourced from Massachusetts and New Jersey. Total U.S. scallop supply has declined recently, as federal quotas have restricted offshore access and larger dayboat scallops are reportedly becoming scarcer. Maine accounts for less than 2% of U.S. scallop volume, yet commands the highest average price per meat pound. According to the Maine DMR, the vast majority (90+) of Maine scallops are from inshore fisheries harvested via day-boat operations.

Projections estimate that domestic supply will lag demand by roughly 50% over the planning horizon under all growth scenarios. Demand above what the U.S. can produce is being met by typically smaller, frozen scallops that are imported from Asia and South America. Current imports totaling 40-million pounds with a value of $350 MM (nearly equals to U.S.-produced volume) represent an opportunity for Maine.

Demand for scallops remains strong year-round, while supply tends to peak during the early periods of the harvest season: Maine (December – April), Massachusetts (November – March), and Federal (March – February). Research suggests that there is an opportunity for farmed scallops to support the wild harvest by providing year-round inventory after wild scallop quotas have been diminished. Given the strong demand for Maine's inshore scallops and accompanying high prices, this suggests that Maine farmed scallops could be a viable source for high-quality scallops during lulls in the wild fishery.

Over the 15-year planning horizon, overall U.S. scallop supply is projected to remain flat to slightly down. Best estimate growth projections assumed development of an aquaculture infrastructure that enables Maine to double its overall scallop volume (wild & farmed) over the horizon from 453,000 to 1.18 MM lbs. by 2030. Under this assumed growth, pricing scenarios find that overall scallop pricing will decline moderately over the planning horizon, but Maine scallops will continue to command a price premium given their high perceived quality.

Despite strong consumer demand and shrinking supply, aquaculture initiatives have not yet gained scale in the scallop market. There is broad consensus that the scallop market is well suited for aquaculture. There is also recognition that farmed scallop techniques need to be tested and optimized before sufficient scale can be achieved.

v. Opportunity Summary and Strategic Implications

The Farmed Shellfish Market Analysis identifies a significant opportunity for Maine to expand its farmed shellfish industry. Based on the "best estimate" projections, the Maine farmed shellfish industry could achieve landed revenues in excess of $30 million by 2030. Achieving the business potential will require:

- Expansion of leased shellfish acreage from 608 to approximately 1,200 acres
- Development of efficient distribution capabilities beyond New England to achieve scale and capture year-round demand for farmed shellfish in the top U.S. markets
- Investment in scallop aquaculture infrastructure and cold-water shellfish harvesting capabilities to extend the shellfish seasons
- Leveraging Maine's brand equity, either through "from Maine" positioning, or by developing specific farm/regional brands linked to Maine to communicate high quality and differentiate Maine's products from competitors'
- A continual focus on achieving operational efficiencies, as pricing is projected to moderate over the planning horizon

EASTERN OYSTER

(Crassostrea virginica)

i. Species Overview

The vast majority of U.S. oysters are sourced via aquaculture from numerous coastal regions across the United States. Aquaculture makes up an estimated 95%+ of all oyster production in the U.S. In total, approximately 900 million oysters are consumed annually in the U.S.

Of this supply, an estimated 525+ million, or approximately 60% are whole (half-shell) and the remaining 370+ million are shucked. Given that the vast majority of Northeast oysters are sold whole for the half-shell market, this report evaluates whole versus shucked dynamics.

Given the strong consumer demand for oysters, supported by a surge in oyster bars and oyster menu listings, consumer demand is projected to continue to outpace supply over the next 3 – 5 years, and will remain strong over the 15-year planning horizon. At the same time, overall supply will remain constrained as the Gulf of Mexico (Gulf) struggles to reestablish its oyster infrastructure in the aftermath of the BP spill and decreasing volume trends prior to the spill. The East Coast supply, particularly for whole oysters, is projected to continue to grow as additional capacity is added from the Mid-Atlantic to the Northeast.

Given these dynamics, pricing is expected to moderate slightly, but remain at relatively high levels over the next 3 – 5 years as capacity lags demand. Longer term price projection models indicate that pricing will continue to soften moderately as capacity begins to catch up with demand.

Maine oysters are considered to be high quality and the most expensive. Some buyers / customers feel that Maine oysters are worth the premium, while others caution that there are numerous other high quality oyster producers with lower prices (Chesapeake, Long Island Sound, etc.).

While the Mid-Atlantic and Southern regions may offer lower prices, numerous buyers stated that they will not purchase any oysters south of Virginia due to quality concerns, including m*ore brittle shells, lower quality meat and lack of flavor.* In the summer, buyers tend to migrate north with their purchases, as the spawning seasons and *Vibrio* risks have less impact on the cold water oysters.

The vast majority of oyster consumption is at restaurants, which account for over 80% of total volume. Within restaurants, there is a trend toward smaller, cocktail sized oysters (<3”), which creates an opportunity for aquaculture operations to harvest their oysters sooner. *Note: Some states stipulate a minimum size limit for harvested and imported oysters.*

While the Chesapeake area has rebounded; it could take years for the Gulf to regain momentum and there is uncertainty whether the Gulf will return to the production levels of the early 2000’s.

There is some concern that, as warmer water locations increase supply, the market may be inundated with a large inventory of lower quality, cheaper oysters. Maine oyster growers should be somewhat insulated from this dynamic, as over 90% of Northeast oysters are sold whole for consumption on the half-shell, and Northeast oysters are perceived to be the quality leaders.

This is particularly the case if oyster farmers can extend the harvesting season via investment in indoor wet storage facilities, etc. Additionally, the consumer movement to smaller sized oysters should enable Maine oyster farmers to bring their oysters to market faster.

ii. Market Size and Growth

The total U.S. supply of oysters is estimated to exceed 900 million oysters, and represents a landed value of approximately $230 million (Table 2). The vast majority of whole and shucked oysters consumed in the U.S. are sourced domestically. Canadian imports are primarily whole oysters, and their value represents the average price per unit entering the U.S., not ex-vessel.

Table 2. 2015 Total U.S. Oyster Supply

Source	Volume - Pieces (000)	Value - $USD (000)
United States	895,320	$214,740
Canada	20,192	$18,133
Total	915,512	$232,873

Source: The Hale Group research, ECSGA, Statistics Canada

The U.S. oyster market supply has experienced erratic growth performance in recent years as strong capacity gains in the Northeast and Mid-Atlantic have been offset by declines in the Gulf and Southeast regions (Figure 2). In total, overall U.S. oyster supply has been flat since 2008. Consensus is that consumer demand remains greater than supply, so positive growth trends are expected to continue in regions with capacity; particularly along the Eastern Seaboard from Virginia to Maine.

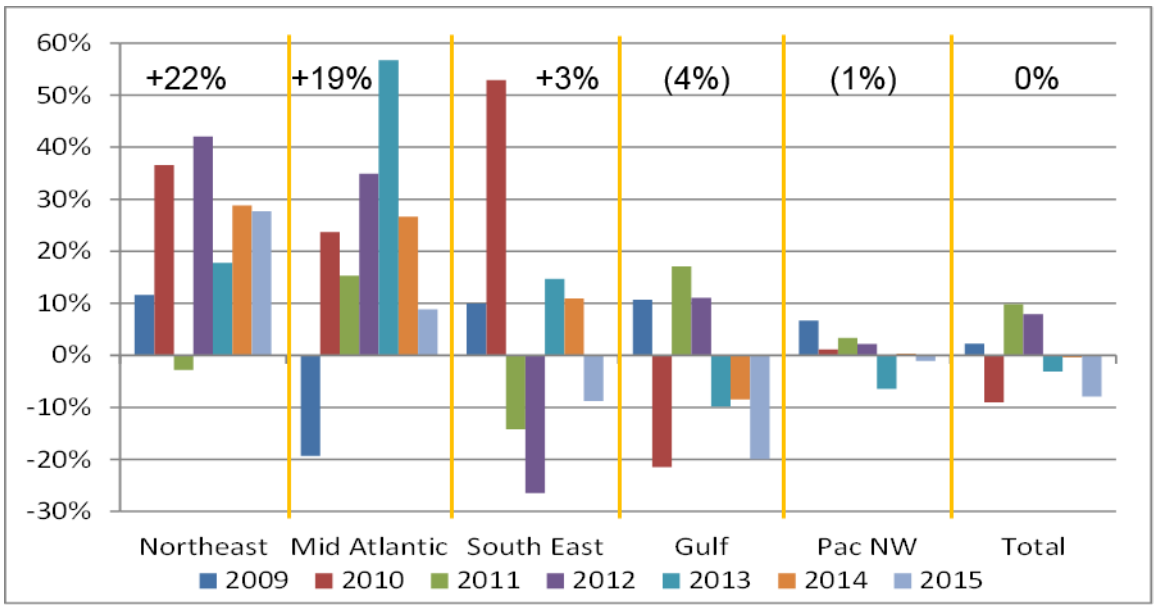


Figure 2. Volume % change vs. prior year in pounds for 2008 – 2015. Source: The Hale Group research, ACCSP

iii. Sourcing

Despite recent supply interruptions, the majority of U.S. oysters continue to be sourced from the Gulf region (Figure 3).

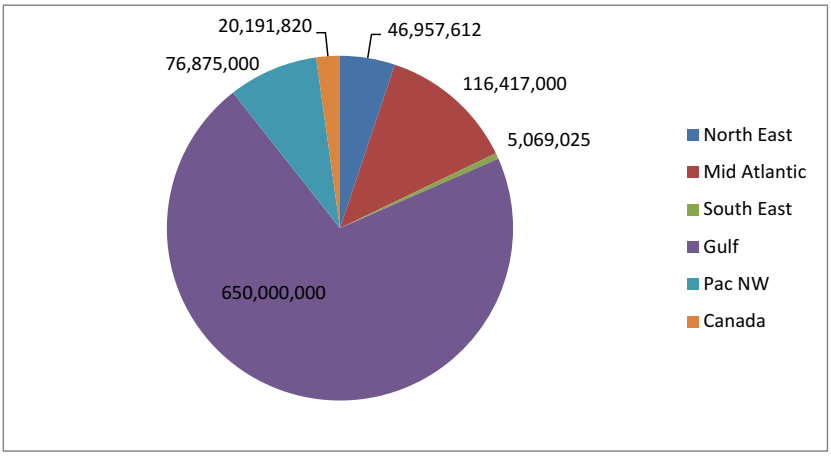


Figure 3. 2015 U.S. Oyster in number of pieces. Source: The Hale Group research, ECSGA, Statistics Canada

There is significant variability in the value of oyster harvest by Region, with the Northeast commanding the highest relative premium among U.S. Regions (Figure 4). *Note: Canadian pricing represents the average price per unit entering the U.S., not ex-vessel.*

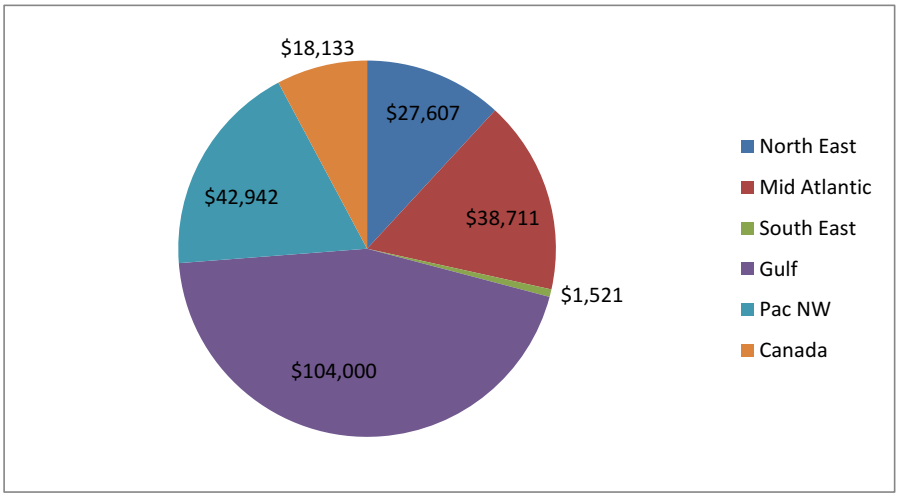


Figure 4. 2015 Oyster landed value in $USD (000). Source: The Hale Group research, ECSGA, Statistics Canada

When evaluated by format, whole oysters account for almost 60% of the volume and over 70% of the value of U.S. oyster production (Table 3). The Northern producing regions command a price premium driven by the perceived higher quality of their oysters, which are primarily sold in the whole format.

Table 3. Oyster whole & shucked regional dynamics in 2015

Region	Whole (Half Shell)			Shucked		
	Volume – Pieces (000)	Value - $USD (000)	Value Per Piece	Volume - Pieces (000)	Value - $USD (000)	Value Per Piece
North East	44,642	$ 26,333	$ 0.59	2,316	$ 1,230	$ 0.53
Mid Atlantic[1]	94,615	$ 35,008	$ 0.37	21,803	$ 3,707	$ 0.17
South East	2,535	$ 1,014	$ 0.40	2,535	$ 507	$ 0.20
Gulf	325,000	$ 55,250	$ 0.17	325,000	$ 48,750	$ 0.15
Pacific NW	61,500	$ 35,055	$ 0.57	15,375	$ 7,887	$ 0.51
Total U.S.	**528,292**	**$ 152,659**	**$ 0.29**	**367,028**	**$ 62,080**	**$ 0.17**
Share	**59% Volume**	**71% Value**		**41% Volume**	**29% Value**	

[1] Includes Connecticut
Source: The Hale Group research, ECSGA, Washington Sea Grant, ACCSP,

In the Northeast, whole oysters account for over 95% of the total oyster supply (Figure 5). The Pacific Northwest also remains a primarily whole oyster producing region. The majority of shucked oysters are sourced from the Gulf. The Mid-Atlantic has recently added spat-on-shell capacity for additional shucked supply, although the majority of Mid-Atlantic oysters remain whole.

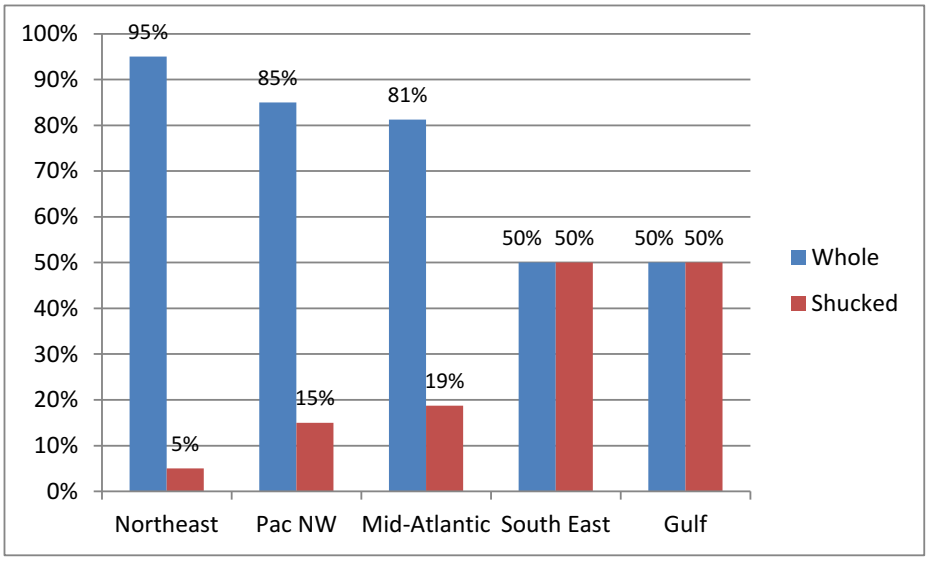


Figure 5. Oyster format shares by region in 2015. Source: The Hale Group research

While the Gulf remains the whole volume share leader, the Northeast and other non-Gulf harvesting areas account for the majority of the whole value share given the higher prices realized for their whole oysters (Figure 6, Figure 7).

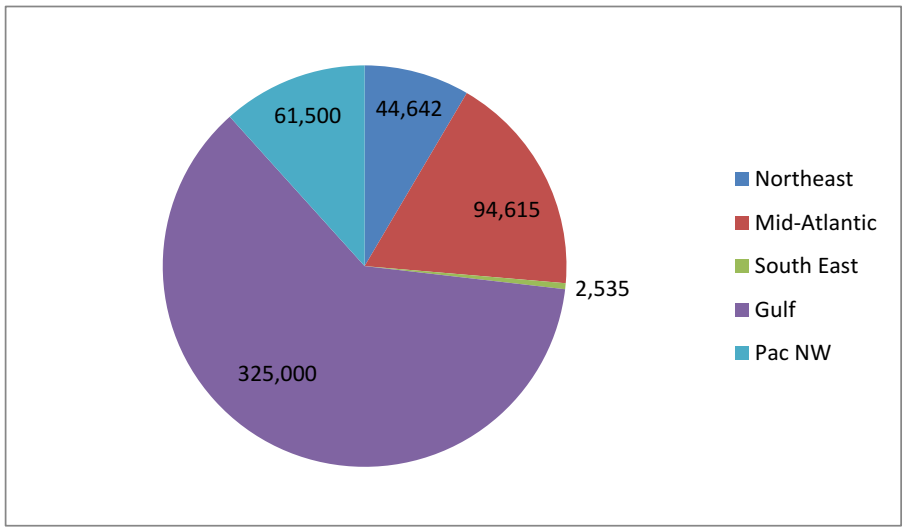


Figure 6. Oyster volumes by region (000 pieces) in 2015. Source: The Hale Group research, ECSGA, Washington Sea Grant, ACCSP

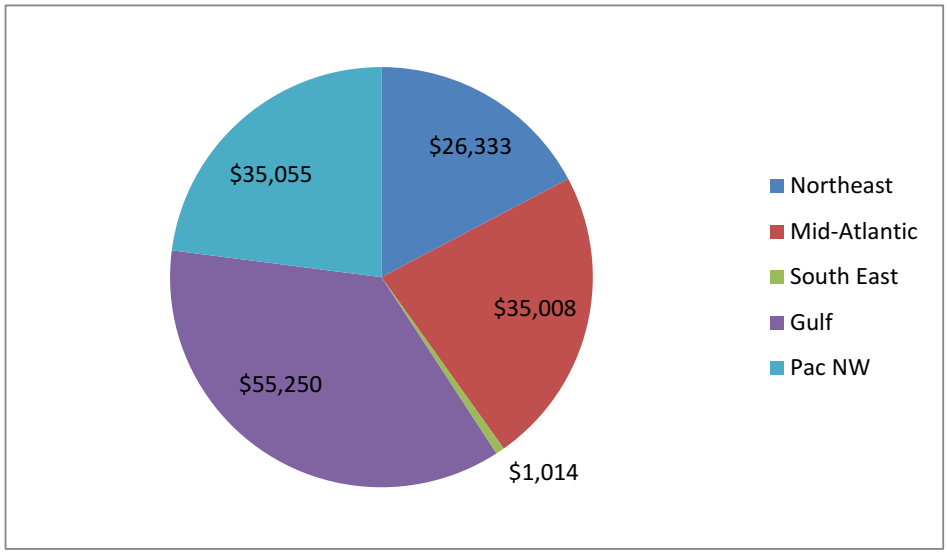


Figure 7. Whole oyster value ($000) in 2015. Source: The Hale Group research, ECSGA, Washington Sea Grant, ACCSP

Within the Northeast, Maine accounts for approximately 14% of the region's total oyster supply (Table 4).

Table 4. Northeast total oyster (whole and shucked) harvest in 2015

Region	Volume - Pieces	Value - $USD (000)	Value Per Piece	Volume Share	Value Share
ME	7,104,480	$4,121	$0.58	15.1%	14.9%
MA	32,106,000	$18,264	$0.57	68.4%	66.2%
NH	200,000	$90	$0.45	0.4%	0.3%
RI	7,547,132	$5,132	$0.68	16.1%	18.6%
North East Total	46,957,612	$27,607	$0.59	100.0%	100.0%

Source: ECSGA, Maine DMR, The Hale Group research

Note: There is anecdotal concern that the Maine DMR farmed Oyster volume may be slightly under-reported and does not include any out-of-state seed sales. To address this concern, The Hale Group has applied a +10% factor to the ECSGA / Maine DMR data at the recommendation of the industry advisory committee.

Note: Rhode Island oyster farmers, through the Ocean State Shellfish Coop, sell a significant percentage of their oysters directly to wholesale distributors, which enables them to receive the higher value. An equivalent landed value in Rhode Island would be comparable to Maine's $0.58 / piece.

When evaluating the whole format only, there is no significant shift in the Northeast's share dynamics given the region's high incidence of whole oyster harvesting (Table 5).

Table 5. Northeast whole format oyster harvest in 2015

Region (% Whole)	Volume - Pieces	Value - $USD (000)	Value Per Piece	Volume Share	Value Share
ME (98+%)	6,975,308	$ 4,046	$0.58	16%	15%
MA (95+%)	30,500,700	$ 17,351	$0.57	68%	66%
NH (95+%)	190,000	$ 86	$0.45	---%	---%
RI (95+%)	7,169,775	$ 4,875	$0.68	16%	19%
North East Total	44,835,783	$26,358	$0.59	100.0%	100.0%

Source: ECSGA, The Hale Group research
Note: There is anecdotal concern that the Maine DMR farmed Oyster volume may be slightly under-reported and does not include any out-of-state seed sales. To address this concern, The Hale Group has applied a +10% factor to the ECSGA / Maine DMR data.

iv. Seasonality

The development of aquaculture since the 1990's has greatly diminished oyster consumption seasonality—particularly as it related to demand for cold water oysters. The old adage of only consuming oysters during months ending in "R" has been largely negated by improved quality control measures.

From a supply perspective, advancements in growing and harvesting techniques have reduced the risk of *Vibrio* concerns and have extended the harvesting and growing season (icing, tagging, cold water storage, ice breaking, etc.). A negative factor that could eventually impact the seasonality of Maine oysters is the impact of global warming on Maine's water temperatures. The impact of warming waters on the risk of *Vibrio* is hard to determine, and quality control measures are expected to continue to be an area of focus by both growers and regulatory agencies.

Nationally, the "Fall Drop Off" has diminished in the view of wholesalers and restaurant operators as they are now able to source high-quality oysters year round. The Fall Drop Off was greatest when customers relied more on warmer water regions to provide oysters for half-shell consumption. At the time, oysters came out of their spawning season in the early fall and needed time to recover before being harvested. The onset of winter further limited harvesting. Now, cold water oyster sourcing, winter harvesting capabilities and quality control measures to mitigate the risk of *Vibrio* contamination have extended the oyster season year round.

The Hale Group research indicates that overall consumer demand for oysters mirrors restaurant seasonality cycles. Restaurant seasonality metrics identify relative low demand periods in January and February; although the monthly restaurant sales during the "low" periods are still within 10% of an average month across the restaurant industry. In general, the fall season is relatively normal for restaurant operators apart from a small decline in September due to the

"back-to-school" season and the end of the traditional summer vacation period. On a national basis, restaurant seasonality by itself does not indicate a significant fall oyster drop off in demand (Figure 8). In areas where restaurant demand is highly seasonal, including Maine, demand can decrease significantly after the primary tourist seasons, indicating that the Fall Drop Off is a local, rather than a national, phenomenon.

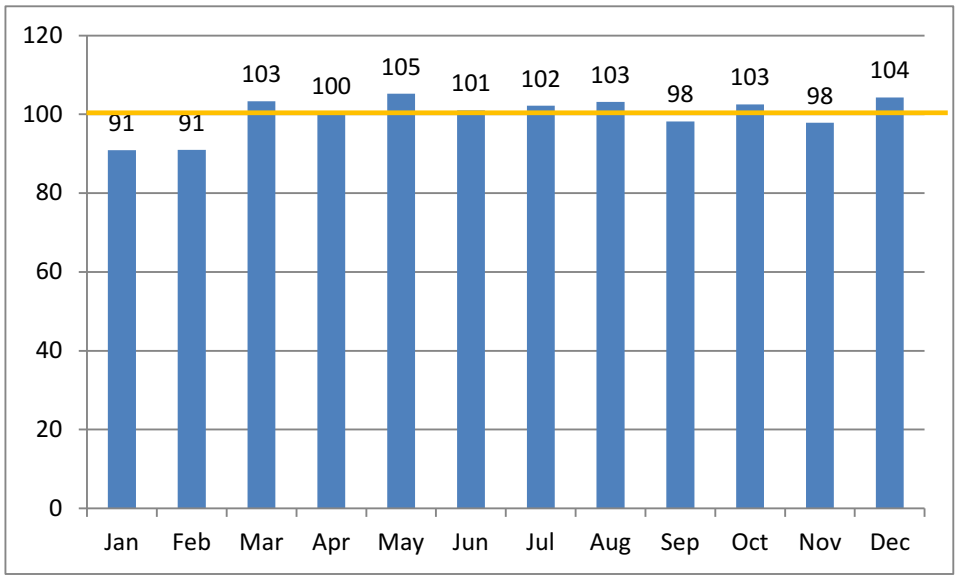


Figure 8. U.S. restaurant seasonality indices: (2011 – 2015). Source: U.S. Census Bureau

For Maine oysters, there are some dynamics that negatively impact Fall demand including:

- Reduction in local demand after the summer Maine tourist season.
- Increased local supply from some New England oyster farmers that are interested in bringing inventory to market in advance of the winter ice-over.

These dynamics underscore the need to expand distribution networks to the major metropolitan areas in the Northeast and beyond. Portland is within 500 miles of four of the Top 10 metropolitan areas in the U.S.; within 1,000 miles of six of the Top 10 (Figure 9); within 2,000 miles of eleven of the top 20; within 300 miles of Montreal; and within 700 miles of Toronto Canada. All of these markets have significant numbers of restaurants that serve shellfish.

All of the U.S. markets within 1,000 miles can be reached by interline refrigerated transfer through Boston within 24 - 48 hours of their departure from Maine. Four of five markets within 2,000 miles (Florida cities, Detroit, and Denver) can also be reached by the same interline transfer from Boston, but refrigerated travel times are likely longer, perhaps 12 additional hours from the Maine departure to Denver. Two Boston interline transfer points are Araho Transfer and Peninsula of Boston which are commonly accessed by refrigerated seafood truck departures from Maine.

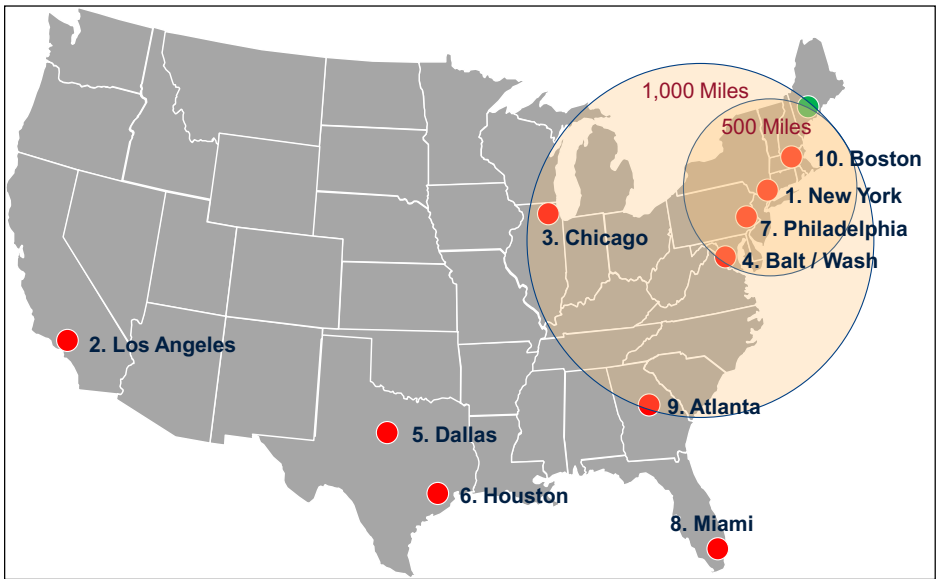


Figure 9. Top 10 U.S. metropolitan areas within 500 and 1,000 miles of Portland Maine. Source: U.S. Census Bureau Metropolitan Statistical Areas 2015.

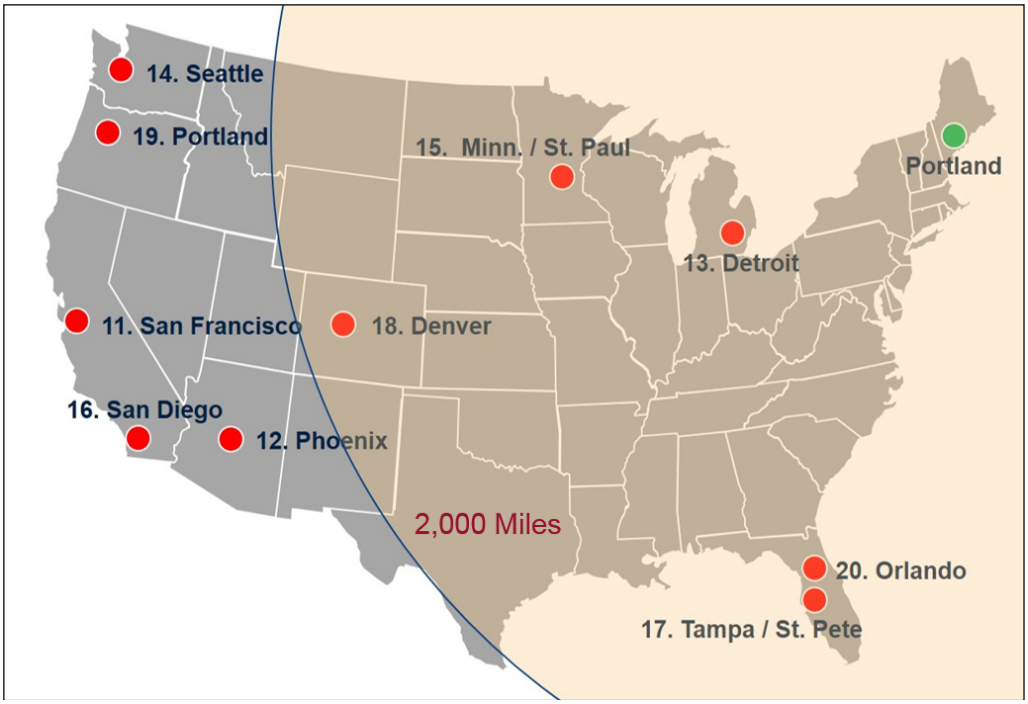


Figure 10. Top 11 – 20 U.S. metropolitan areas within 2,000 miles of Portland Maine. Source: U.S. Census Bureau Metropolitan Statistical Areas 2015.

From a demand perspective, the growth of raw bars and the addition of oysters to menus as a relatively low cost, high margin item that is well-suited for sharing has led to a significant increase in demand for oysters. This explosion of menu occasions has coincided with a greater consumer interest in smaller oysters, which creates an opportunity for Maine oyster farmers to better compete with warmer water competitors that benefit from faster growth cycles.

v. Value chain

The oyster value chain can be somewhat convoluted, as supply chain participants can play numerous roles in the process (Figure 11, Table 6). In general, harvesters sell oysters to dealers, who then process the oysters for wholesale distribution.

Note: The value per oyster in this research report is the landed price paid to the harvester based on the various reporting sources. In many cases, the harvester performs the function of the aggregators and processors within the value chain and realizes the incremental revenue associated with these aspects of the supply chain. In some cases, the oyster harvester sells directly to an aggregator / processor that realizes the economic benefit of preparing and packaging the oysters for distribution.

The typical oyster value chain is as follows:

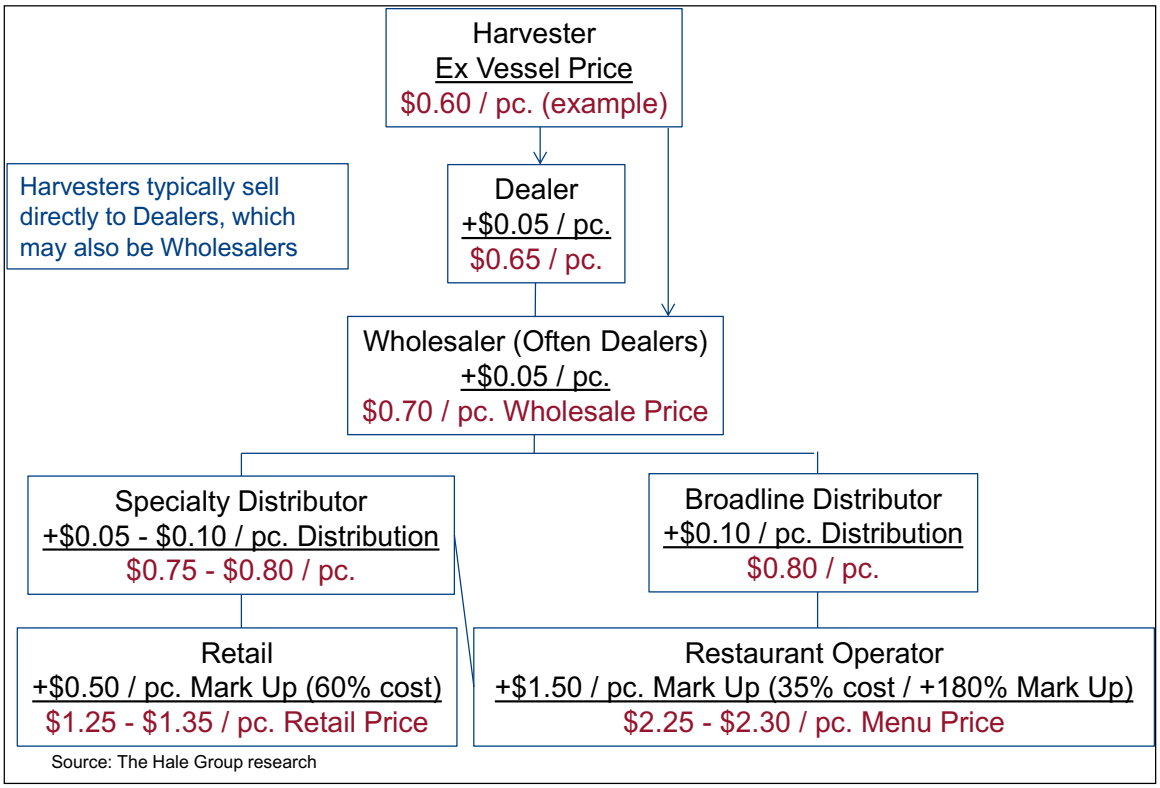


Figure 11. Oyster Value Chain

Table 6. Value Chain definitions.

Participant	Definition
Harvester	Oyster farmer that grows and retrieves oysters from the sea farm for sale.
Dealer	A person or business to whom certification is issued for the activities of shellstock shipper, shucker-packer, repacker, reshipper, or depuration processor. Dealers may also be harvesters, wholesalers or distributors.
Wholesaler	Business entity that purchases and distributes shellfish from dealers either to distributors for further transportation or directly to retail and foodservice customers.
Specialty Distributor	Seafood distributors that purchase shellfish from dealers or wholesalers for distribution to retail and foodservice customers.
Broadline Distributor	Foodservice distributor that carries a wide variety of products, including seafood, for distribution to foodservice customers.
Retail	Grocery and seafood stores that sell directly to consumers.
Restaurant Operator	Restaurant locations that prepare and sell meals to consumers.

vi. Growth Projections - National

Nationally, the oyster marketplace is projected to continue to expand, with the Northeast and Mid-Atlantic adding capacity over the planning horizon and a projected ultimate recovery in the Gulf region. In total, oyster supply is projected to grow an incremental +350 million pieces over the planning horizon. Based on The Hale Groups best estimates, this equates to approximately +2.2% average annual growth (Table 7, Figure 12 & 13).

Oyster growth is projected to be driven by a combination of both increased supply and continued growth in demand. Demand drivers include:

- Population growth of approximately 0.8% annually
- Modest increase in per capita oyster consumption; with a planning assumption of returning to 2000 per capita levels (3.3 oysters) driven by increased supply and continued interest in half-shell oysters
- Restaurant unit expansion of approximately 0.5% - 1% annually. Over the next 3 – 5 years, it is projected that oyster menu placement growth will exceed overall industry growth by 2 – 3 times (Source: THG operator interviews, Seafood Business, Datassential).

Based on best estimate supply and demand projections, US oyster supply will lag demand until the final years of the strategic planning horizon. The primary Supply & Demand assumptions include supply growth in all primary markets at the following levels (Table 7).

Table 7. US oyster supply growth projections

Region	Current Supply Pieces (000)	Annual Capacity Growth			Proj. 2030 Supply Pieces (000)
		2015 - 2020	2021 - 2025	2026 - 2030	
Maine	7,104	10.0%	6.0%	4.0%	18,629
Rest North East	39,853	4.0%	2.0%	1.0%	56,265
Mid Atlantic	116,417	7.0%	4.0%	2.0%	217,131
South East	5,069	3.0%	3.0%	3.0%	7,897
Gulf	650,000	1.0%	2.0%	2.5%	853,376
Pac NW	76,875	2.0%	1.5%	1.0%	91,481
Canada	20,192	1.0%	1.0%	1.0%	23,442
Total	**915,510**	**2.0%**	**2.2%**	**2.6%**	**1,268,221**

Source: The Hale Group research

Note: Growth projections are based on analysis of anticipated future demand and supply growth dynamics; not derived from past growth trends.

Table 8. US oyster supply growth assumptions

Assumptions	
Maine:	Current applications for 75 new lease acres = + 25% capacity (approx. 1,600,000+ Oysters by 2020) Increased build-out of existing lease sites = + 3% - 5% annually through 2020 Expanded lease sites beyond current Damariscotta locations for long term growth
Rest North East	Modest site expansion in short term Relatively low growth in mid-to-long term due to location expansion constraints (+1% - 2%)
Mid Atlantic	VA Aquaculture Shellfish Report projects + 30% growth in short term supply (+7% annual average) Assume moderate growth after initial 3 - 5 year period (+2% - 4%)
Gulf	Assume eventual modest recovery of Oyster beds
Pac NW	Assume continued capacity constraints; limited growth (+1% - 2%)
Canada	Assume Low growth due to preference for North East U.S. Oysters; currency rates could impact growth

Demand: To estimate true demand The Hale Group utilized per capita demand from 2000 of 3.3 oysters, which represents a benchmark prior to the Gulf issues and other supply disruptions, and projected future demand based on U.S. Census population growth projections. *Note: Current supply equates to 2.85 oysters per person, and 1990 per capita consumption was approximately 4.0 oysters per person.*

Figure 12. Projected U.S. oyster supply and demand (000 pieces). Source: The Hale Group Research

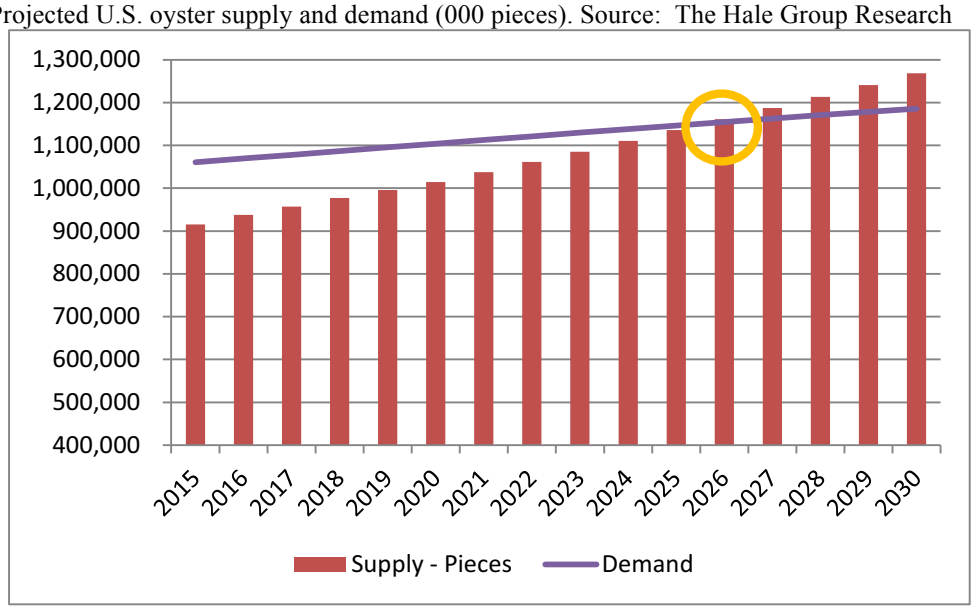
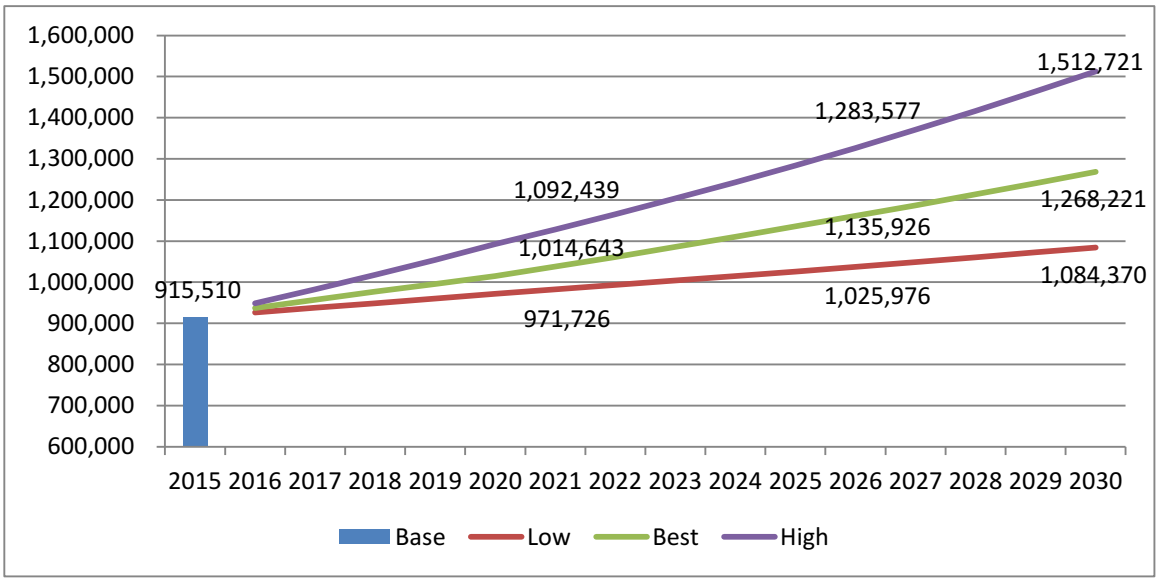


Figure 13. Projected U.S. oyster volume growth (000 pieces). Source: The Hale Group research, ECSGA, ACCSP, GSMFC



The Northeast, and Maine in particular are projected to be growth leaders as capacity is added and demand continues for high quality cold-water oysters (Table 9). Regionally, the rate of growth in the Northeast and Mid-Atlantic is projected to moderate as capacity is built out; while the Gulf is projected to expand as capacity is rebuilt. The Pacific Northwest is projected to maintain a moderate, but steady growth rate.

Table 9. Oyster regional volume growth projections (pieces).

Region	2015 Volume (000)	Proj. Annual % Chg. '15 – '20	Best Proj. 2020 Vol. (000)	Proj. Annual % Chg. '20 – '25	Best Proj. 2025 Vol. (000)	Proj. Annual % Chg. '25 – '30	Best Proj. 2030 Vol. (000)
Maine	**7,104**	**10.0%**	**11,442**	**6.0%**	**15,312**	**4.0%**	**18,629**
Rest North East	39,853	4.0%	48,487	2.0%	53,534	1.0%	56,265
Mid Atlantic[1]	116,417	7.0%	161,642	4.0%	196,663	2.0%	217,131
South East	5,069	3.0%	5,876	3.0%	6,812	3.0%	7,897
Gulf	650,000	1.0%	683,157	2.0%	754,260	2.5%	853,376
Pacific NW	76,875	2.0%	82,816	1.5%	87,041	1.0%	91,481
Total U.S. Regions	**895,318**	**2.1%**	**993,420**	**2.3%**	**1,113,622**	**2.3%**	**1,244,779**
Canada	20,192	1.0%	21,221	1.0%	22,304	1.0%	23,442
Grand Total	**915,510**	**2.0%**	**1,014,641**	**2.2%**	**1,135,926**	**2.6%**	**1,268,221**

[1] Includes Connecticut

Source: The Hale Group research, ECSGA, Washington Sea Grant, ACCSP, GSMFC, Statistics Canada

Note: Connecticut data was included in the Mid-Atlantic Region to reflect the state's geographic and economic alignment with the Metro New York metropolitan area, which is included in the Mid-Atlantic Region.

As additional capacity is added in most regions, the expectation is that pricing will begin to moderate, particularly for lower priced southern oysters as Gulf capacity is expected to recover. While pricing is expected to recede moderately over the planning horizon, regression analysis indicates that there has been minimal correlation between price and volume (consumption) over the past decade. When comparing ACCSP data for landed meat pounds relative to the value per pound of the oyster landings, the R Square correlation metric of .62 indicates minimal correlation between volume and price (Table 10).

Table 10. Historical regression analysis output: meat volume vs. pricing. Total U.S. Includes all oyster formats and landings.

Year	Landed Meat Lbs.	$ / Lb	SUMMARY OUTPUT	
2005	3,498,616	$ 4.97		
2006	4,371,775	$ 5.38	*Regression Statistics*	
2007	6,309,601	$ 4.06	Multiple R	0.794128903
2008	5,368,016	$ 5.52	R Square	0.630640715
2009	5,488,183	$ 5.61	Adjusted R Square	0.589600794
2010	5,700,866	$ 6.68	Standard Error	1027728.761
2011	6,762,623	$ 6.12	Observations	11
2012	7,490,479	$ 6.96		
2013	7,631,717	$ 9.12		
2014	8,078,372	$ 11.59		
2015	8,691,126	$ 12.75		

Source: ACCSP data

This dynamic underscores the fact that demand has outstripped supply in recent years and suggests that oyster pricing may not experience a significant decline as capacity is created, particularly if whole oyster farmers continue to build brand equity for their products. Northeast pricing, while expected to recede moderately, will remain among the highest nationally.

While oyster pricing cannot be statistically linked to volume changes based on historical patterns, The Hale Group's research indicates that oyster pricing may continue to rise slightly over the next 3-5 years as demand continues to outstrip supply (Figure 14 & 15). As supply begins to catch up to demand, the assumption is that pricing will begin to moderate. Projected best estimate pricing changes are as follows:

- 2016 – 2020: +0.5% annual increases as demand for whole oysters continues to grow and shucked oyster supply is constrained due to Gulf capacity issues.
- 2021 – 2025: -1.0% annual decreases as additional capacity is added to the supply system
- 2026 – 2030: -2.0% annual decreases as total oyster supply is projected to finally catch up with demand

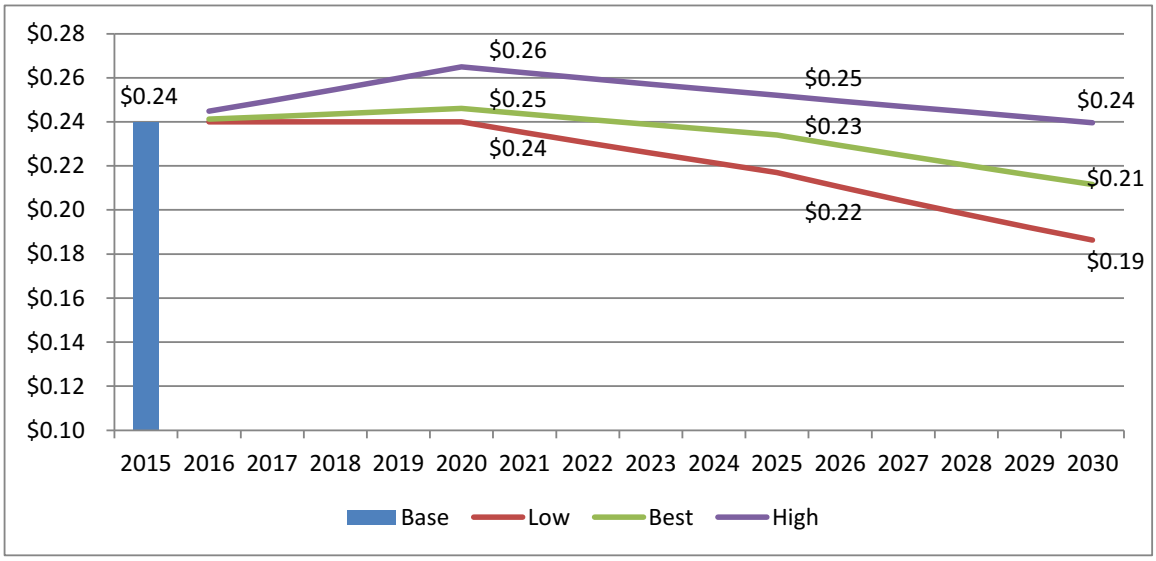


Figure 14. Projected average total U.S. oyster price per piece (ex-vessel). Source: The Hale Group research, ECSGA, ACCSP, GSMFC.

Based on the research findings, the total landed value of the U.S. oyster harvest is projected to reach approximately $270 million by 2030 (Figure 15). Canadian live imports contribute an additional $20+ million in supply.

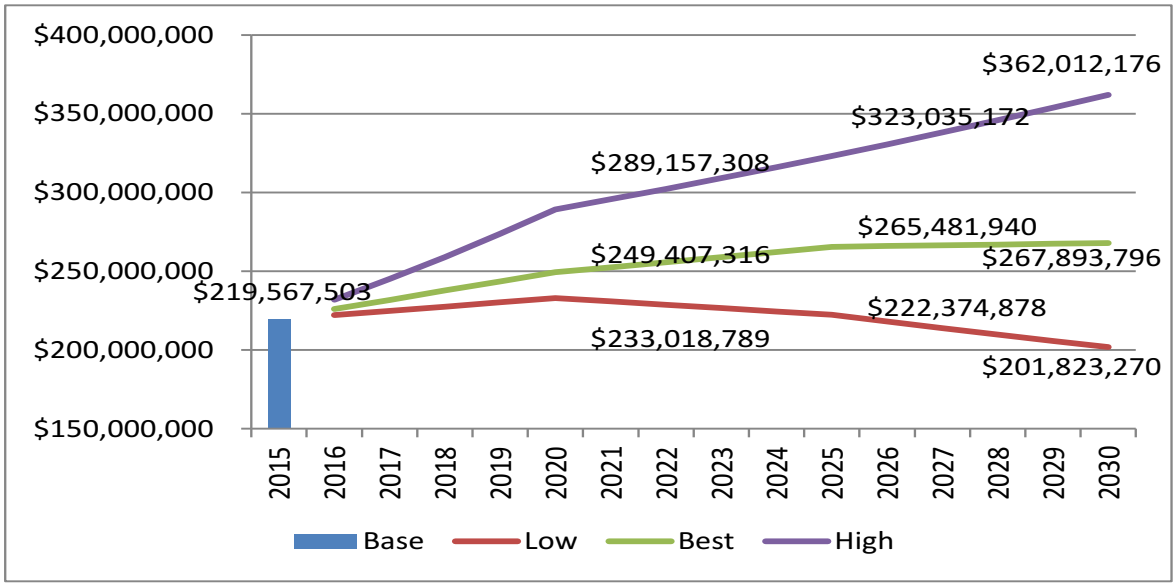


Figure 15. Projected oyster total U.S. landed value ($USD). Source: The Hale Group research, ECSGA, ACCSP, GSMFC.

When evaluating the projected future relationship between supply and pricing, there is a tighter correlation between volume (supply) and pricing as supply is eventually projected to catch up to demand (Table 11).

Table 11. Future Regression Analysis Output: Projected Pieces vs. Pricing. Total U.S. All Oyster Formats and Landings.

Year	Proj. Pieces	$ / 100
2015	915,510,457	$ 24.00
2016	937,463,844	$ 24.00
2017	956,963,328	$ 24.00
2018	977,324,710	$ 24.00
2019	995,671,173	$ 24.00
2020	1,014,642,582	$ 25.00
2021	1,037,644,339	$ 24.00
2022	1,061,254,264	$ 24.00
2023	1,085,491,290	$ 24.00
2024	1,110,375,034	$ 24.00
2025	1,135,925,827	$ 23.00
2026	1,161,161,212	$ 23.00
2027	1,186,993,592	$ 22.00
2028	1,213,437,653	$ 22.00
2029	1,240,508,453	$ 22.00
2030	1,268,221,431	$ 21.00

SUMMARY OUTPUT	
Regression Statistics	
Multiple R	0.873229
R Square	*0.762529*
Adjusted R Square	0.744262
Standard Error	53791501
Observations	15

Source: The Hale Group research

vii. Growth Projections - Maine

As noted earlier, Maine is projected to be a growth leader in oyster supply, driven by increased capacity and continued demand for high-quality, cold water whole oysters. The best, or mid-point, projection estimates that Maine capacity will almost triple over the 15-year planning horizon, generating an incremental 10+ million oysters (Figure 16).

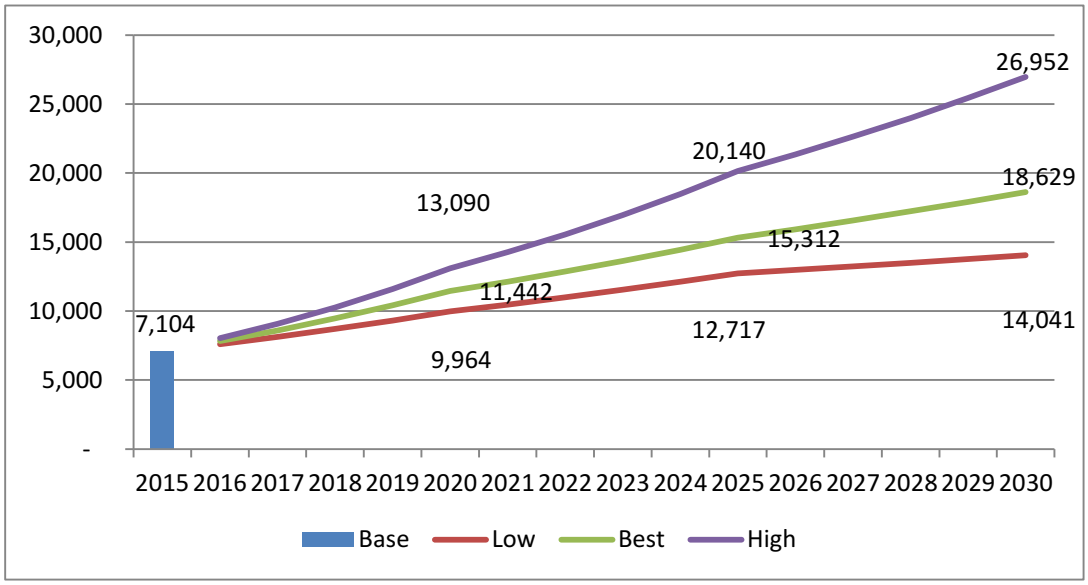


Figure 16. Projected Maine oyster volume growth (000 pieces). Source: The Hale Group research, ECSGA, ACCSP, GSMFC

Key assumptions behind the Maine oyster growth projections include:

Best Estimate:

- 75 current new lease acre applications = + 25% capacity (approx. 1.8 million incremental oysters by 2020)
- The addition of approximately 30 new oyster lease acres per year to meet projected demand
- Increased build-out of existing lease sites = + 3% - 5% annually through 2020
- Expanded lease sites beyond current Damariscotta locations for long term growth
- Expansion of Maine oysters to Top 10 markets within 1,000 miles

Low Estimate:

- Only one-half of current new lease applications are commercialized
- Minimal site expansion beyond the Damariscotta river
- Distribution focus on New England only

High Estimate:

- Accelerated growth in new lease applications
- Investment in Maine / Harvester brand development
- Growth in per capita consumption beyond 2000 levels
- Geographic expansion beyond New England

In order to meet this projected best estimate volume growth, Maine farmed oyster capacity will need to grow at an average of approximately 30 new acres annually though the planning horizon. This equates to an additional 400 lease acres beyond the current 75 acres under review. This assumes that current oyster lease sites are near capacity.

The average landed price for Maine oysters is projected to remain relatively high, although the research indicates that all pricing will moderate as nationwide capacity increases (Figure 17). Maine's reliance on whole, or half-shell, formats should provide some insulation from the anticipated growth in lower cost Gulf and Mid-Atlantic oysters, which have a greater mix of shucked oysters; but pricing projections assume that Maine pricing will be impacted by the expansion of whole supply, particularly from the Mid-Atlantic.

As noted earlier, the research indicates that Maine pricing may decline below $0.50 / oyster (2016 equivalent $USD) by the end of the planning horizon as projected supply catches up with demand. The Hale Group believes that Maine oyster farmers will need to plan for this scenario over the next decade, both by pursuing operational efficiencies and by investing to develop their brands to help differentiate Maine oysters from the rest of the supply in order to justify a price premium.

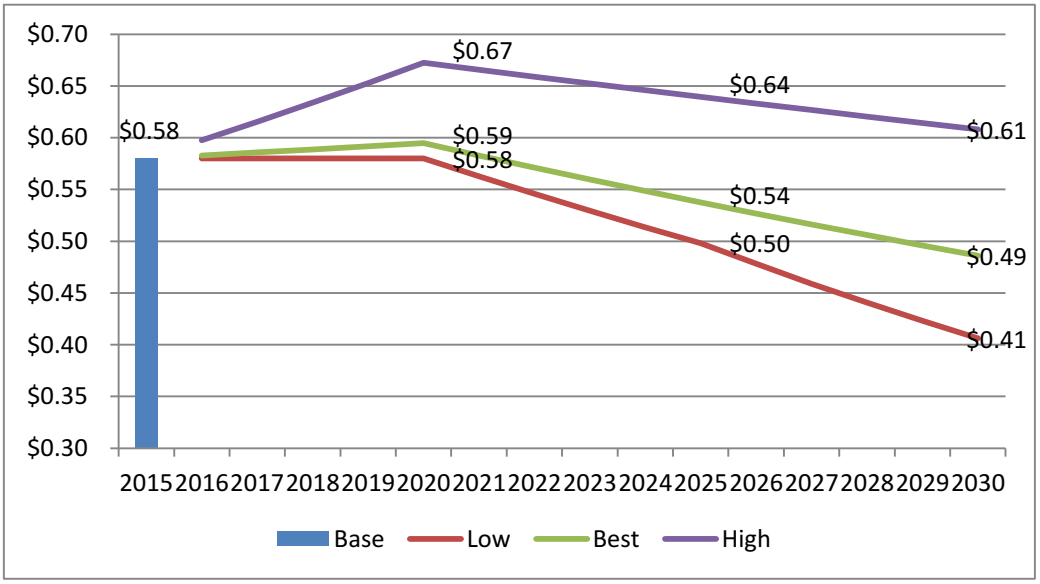


Figure 17. Projected Average Maine Price per Oyster (Ex Vessel Value). Source: The Hale Group research, ECSGA, ACCSP, GSMFC

The Hale Group's research indicates that Maine oyster pricing trends should generally mirror overall national oyster pricing trends, although Maine will continue to command a premium price for its oysters. Projected best estimate pricing changes are as follows:

- 2016 – 2020: +0.5% annual increases as demand for whole oysters continues to grow.
- 2021 – 2030: -2.0% annual decreases as additional lower price whole capacity is added to the East Coast supply system and total oyster supply is projected to finally catch up with demand

Based on the volume and landed pricing research, the total value of Maine oysters is projected to more than double to $8 - $10 million by 2030 (Figure 18).

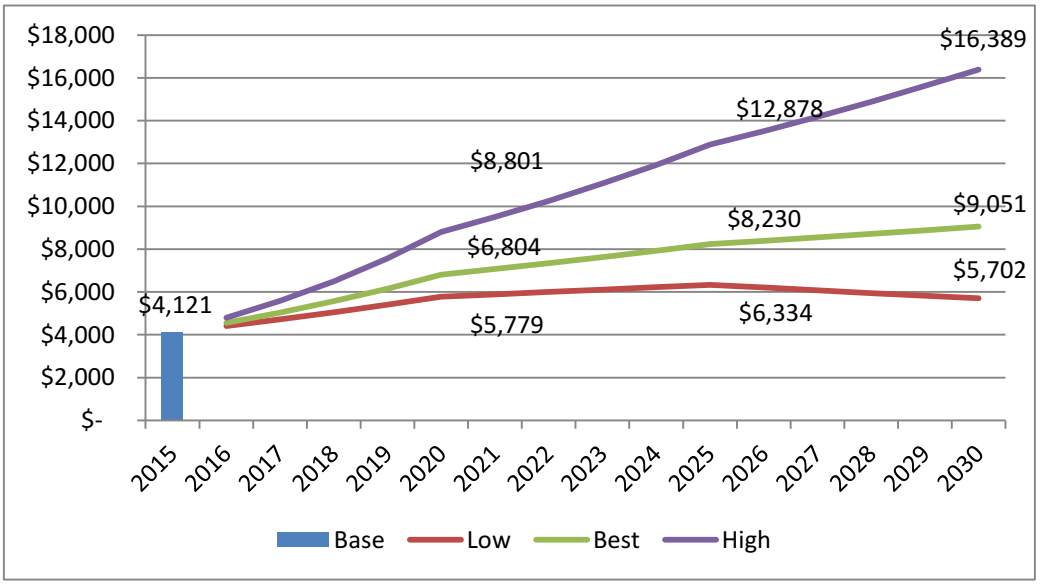


Figure 18. Projected Maine total landed value ($USD - 000)

A review of historical growth shows that Maine's oyster production has more than doubled over the past decade (Figure 19).

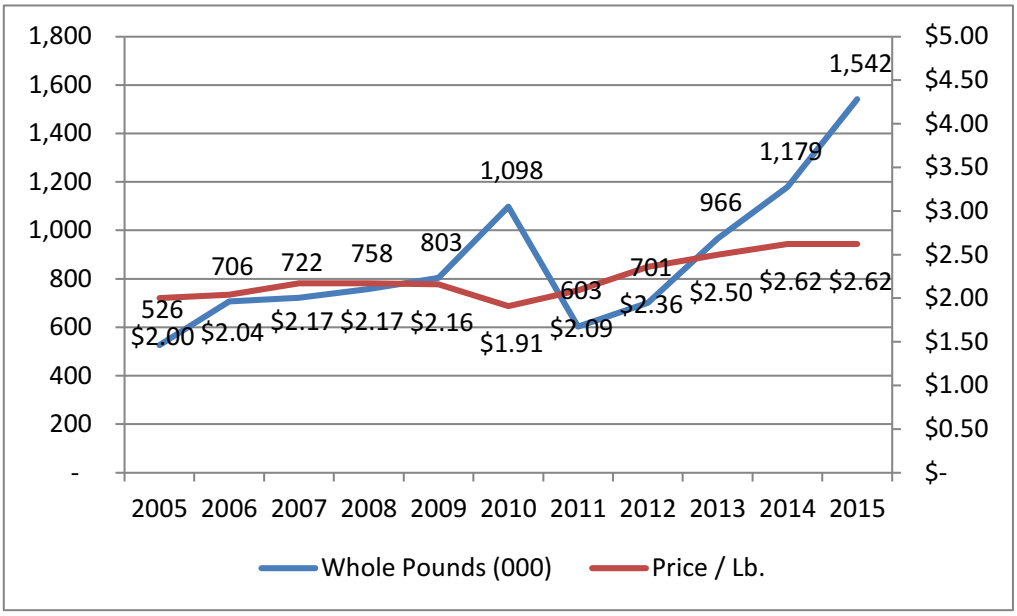


Figure 19. Maine historical oyster growth—DMR. Source: Maine DMR

Maine's growth trends are similar when using either DMR or ACCSP data (Figure 20).

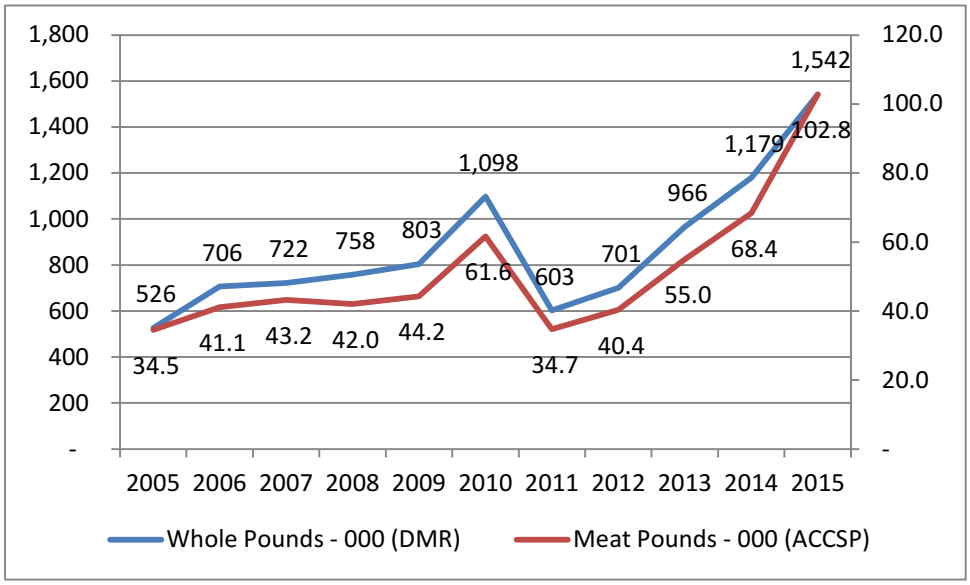


Figure 20. Maine historical oyster growth—DMR and ACCSP. Source: Maine DMR, ACCSP

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BLUE MUSSEL

(Mytilus edulis)

i. Species Overview

Live mussels represent a 60 million pound, and approximately $70 million ex-vessel value industry in the U.S. Research indicates that aquaculture products account for approximately 15% of the U.S. supply and the majority of the Canadian supply. Maine DMR data indicates that aquaculture accounts for 7% of Maine's volume, which THG research indicates may be somewhat under-reported.

U.S. live, fresh mussel demand is primarily sourced from the Northeast (37%), the Pacific Northwest (20%) and Canada (43%). Maine and Massachusetts are the major Northeast producers. Given its close proximity to New England, PEI mussels are a significant competitor for Maine mussels, and have been viewed as an industry standard for a long time. Over-crowding in PEI mussel areas as well as growing recognition of Northeast mussels' quality, have diminished PEI's quality perception and image among some customers; although PEI mussels remain the industry standard for many.

Overall mussel demand is projected to continue to grow modestly over the planning horizon. Part of this growth is driven by a halo effect from oysters where the interest in trying mussels from various farms and areas has a similar appeal as with oysters. Also, mussels are a relatively low cost protein offering for restaurants and consumers. While overall species growth may be moderate, buyers believe that there is significant growth potential for high quality, premium mussels.

Maine, and Northeast mussels in general, are projected to grow at faster rates than Canadian imports given the quality differences.

There is a significant U.S. import market for frozen mussels from New Zealand and Chile. The New Zealand mussels have a reputation for high quality, and Chile produces pre-cooked mussels at a low cost. These products do not have a high level of penetration in New England given the availability of fresh mussels.

ii. Market Size and Growth

The total U.S. live mussels marketplace is estimated to be approximately 60 million whole pounds, with a landed value of approximately $70 million (Table 12). In the U.S., the majority of mussels are sourced from Maine, Washington, and Massachusetts. Close to one-half of the U.S. supply is sourced from Canada.

Table 12. Total U.S. mussel supply in 2015.

Source	Volume – Whole Pounds (000)	Value - $USD (000)
United States	34,577	$35,155
Canada	25,915	$33,138
Total	60,492	$68,293

Source: The Hale Group research, Statistics Canada, Maine DMR, Washington Sea Grant, ACCSP

Note: Whole mussel pounds were estimated based on the following research findings / assumptions:

- Maine: Maine DMR landings data, with farmed adjusted from 958,000 lbs. to 1,350,000 lbs. to adjust for projected under-reporting.
- Massachusetts: DMF input and ACCSP meat weight data converted to whole pounds. Meat weight conversion factor of 40% of total whole mussel weight.
- Pacific NW: Washington Sea Grant research and THG research
- Canadian whole weight and value ($1.29 / lb. USD) is from Statistics Canada data.
- US value is estimated using an average $0.90 per pound price for wild mussels; $1.60 / lb. for farmed outside of Maine and $1.77 / lb. for Maine farmed (blended average of bottom culture and rope grown). *Note: Maine DMR data suggests $0.09 / wild pound and $1.31 / farmed pound.*

The U.S. live mussel supply, including Canadian imports, has grown at approximately a +4% annual rate since the 2008 recession (Figure 21, Table 13). Recently, Massachusetts has driven much of the growth, particularly in 2015 when additional wild capacity became available. In total since 2008, Canadian supply has increased moderately, although Canadian mussel exports to the U.S. have declined in recent years. Canada's 2015 decline was primarily attributed to the harsh 2014/2015 winter. Maine's mussels supply has remained relatively stable in recent years after a decline in the early 2000s.

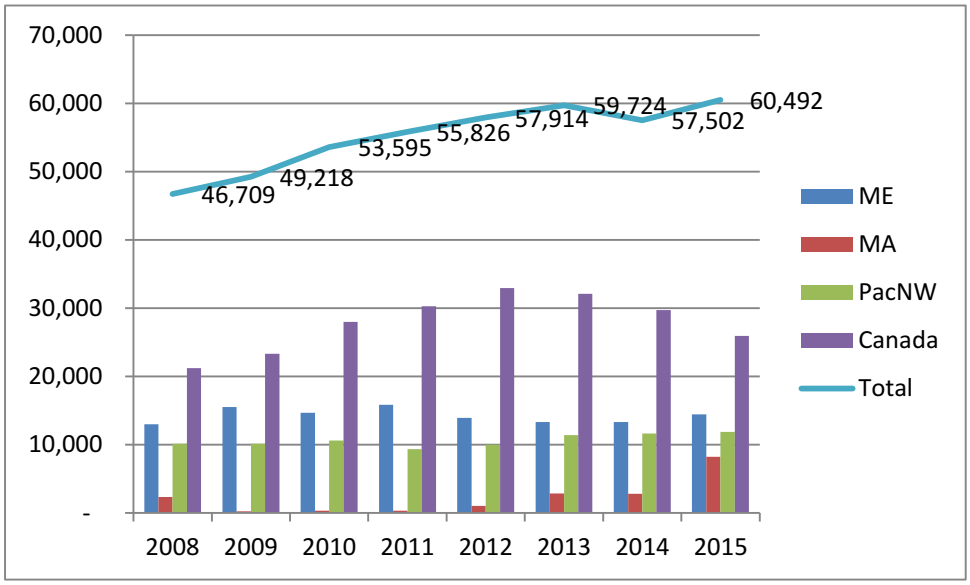

Figure 21. US Live mussel supply (wild & farmed) from 2008 – 2015 (000 lbs). Source: The Hale Group research, Statistics Canada, Maine DMR (unadjusted), Washington Sea Grant, ACCSP

In total, Maine accounts for almost one-quarter of domestic live mussel supply (Table 13, Figure 22).

Table 13. Mussel Regional Supply Dynamics (Wild and Farmed) – 2015. Source: The Hale Group research, Statistics Canada, Maine DMR, Washington Sea Grant, ACCSP

Region	Volume – Lbs. (000)	Value - $USD (000)	Volume Share
ME	14,460	$14,194	24%
MA	8,230	$7,463	14%
Pac NW	11,887	$13,498	20%
Canada	25,915	$33,138	42%
Total Live	60,492	$68,293	100.0%

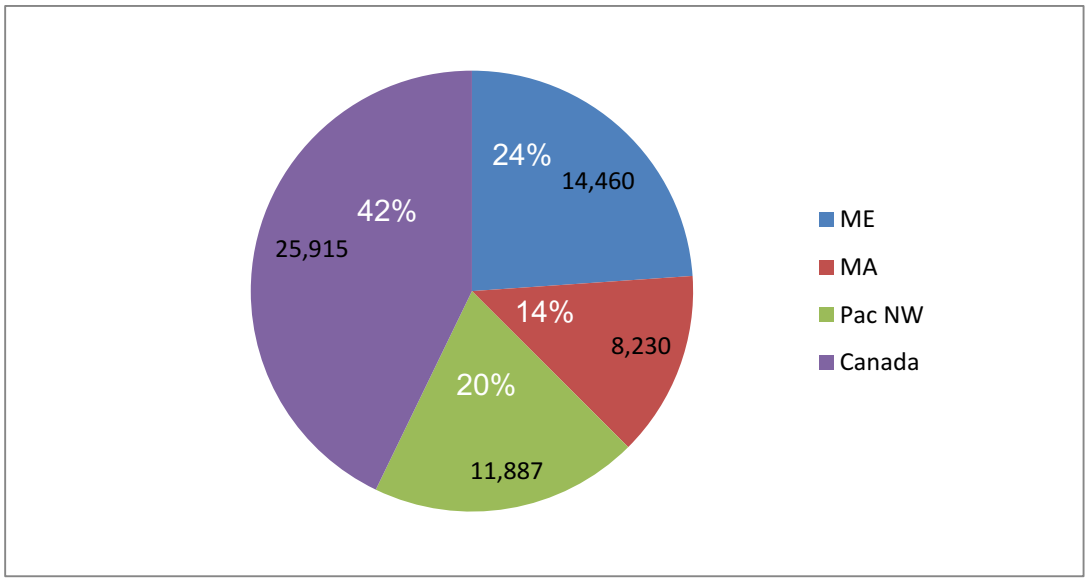

Figure 22. US live mussel supply (wild & farmed) volume (000 lbs.) and shares in 2015. Source: The Hale Group research, Statistics Canada, Maine DMR, Washington Sea Grant, ACCSP

In total, approximately one-half of U.S. mussel supply is sourced via aquaculture (Table 14 & 15). THG research indicates that aquaculture accounts for less than 20% of U.S. mussel supply and the vast majority of Canadian supply. In Maine, aquaculture accounts for an estimated 9% of total mussel supply.

Table 14. Farmed vs. wild mussel volumes in 2015 (000 lbs.)

Region	Est. Farmed Volume – Lbs. (000)	Wild Volume – Lbs. (000)	Total Volume – Lbs. (000)	Farmed % Total Volume
ME	**1,350**	**13,110**	**14,460**	**9%**
MA	80	8,150	8,230	<1%
Pac NW	4,000	7,887	11,887	34%
Total U.S.	5,430	29,147	34,577	16%
Canada	23,300	2,615	25,915	90%
Total Live	28,730	31,762	60,492	47%

Source: The Hale Group research, Statistics Canada, Maine DMR, Washington Sea Grant, ACCSP, MA Marine Fisheries

Farmed mussels command a price premium in the marketplace (Table 15), driven by their higher meat content and perceived higher quality (cleaner, better shell structure, etc.).

Table 15. Farmed vs. wild mussel volumes and values in 2015.

	Farmed			Wild			Total		
Region	Est. Lbs. (000)	Est. $ / Lb.	Est. Value ($000)	Est. Lbs. (000)	Est. $ / Lb.	Est. Value ($000)	Est. Lbs. (000)	Est. $ / Lb.	Est. Value ($000)
ME	**1,350**	**$1.77**	**$2,395**	**13,110**	**$0.90**	**$11,799**	**14,460**	**$0.98**	**$14,194**
MA	80	$1.60	$128	8,150	$0.90	$7,335	8,230	$0.91	$7,463
Pac NW	4,000	$1.60	$6,400	7,887	$0.90	$7,098	11,887	$1.14	$13,498
Total U.S.	5,230	$1.65	$8,923	29,147	$0.90	$26,232	34,577	$1.02	$35,155
Canada	23,300	$1.31	$30,523	2,615	$1.00	$2,615	25,915	$1.28	$33,138
Total	**28,530**	**$1.37**	**$39,446**	**31,762**	**$0.91**	**$28,847**	**60,492**	**$1.13**	**$68,293**

Source: Maine DMR, The Hale Group research, ACCSP, Washington Sea Grant

The research indicates that the Maine farmed mussel harvest appears to be under-reported in the Maine DMR landings data. Based on research findings and discussions with growers, THG developed the following projection for the 2015 Maine mussel harvest:

Table 16. Maine volume estimate (000 lbs.) for rope-grown, bottom culture, and wild mussels in 2015.

Harvest Process	Maine DMR Data	THG Est. Range	Mid-Point Used for Estimates
Farmed – Rope Grown	---	500 - 600	550
Farmed – Bottom Culture	---	700 - 900	800
Total Farmed	**958**	**1,200 – 1,500**	**1,350**
Wild	13,110	13,110	13,110
Maine Total	**14,069**	**14,310 – 14,610**	**14,460**

Source: Maine DMR, The Hale Group research

Within Maine mussel aquaculture, rope-grown mussels achieve a greater price premium relative to bottom-culture mussels (Table 17).

Table 17. Maine mussel pricing dynamics in 2015.

Harvest Process	Est. Lbs. – 000 (Mid Point Est.)	Est. Landed $ / Lb.	Est. Value ($000)
Farmed – Rope Grown	550	$2.10	$1,155
Farmed – Bottom Culture	800	$1.55	$1,240
Total Farmed	**1,350**	**$1.77**	**$2,395**
Wild	13,110	$0.90	$11,799
Maine Total	**14,460**	**$0.98**	**$14,194**

Source: Maine DMR, The Hale Group research

Maine mussel volume trends indicate that supply has been relatively stable in recent years, although overall volume is less that the early 2000s. Based on Maine DMR data, Maine farmed mussel volume has been somewhat erratic in recent years (Figure 23).

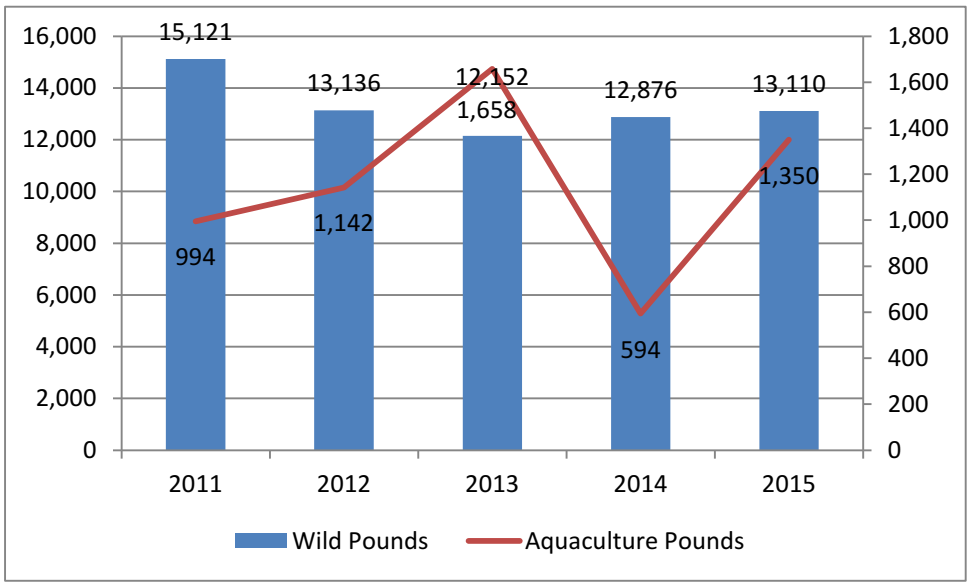

Figure 23. Maine live mussel farmed vs. wild volume trends 2011 – 2015 (000 lbs.). Source: Maine DMR and THG research (Maine Farmed adjusted +40% for under-reporting)

The vast majority of live mussels are sourced from the Northeast and Canada. Frozen and pre-cooked mussels are also sourced from New Zealand and Chile (Figure 24).

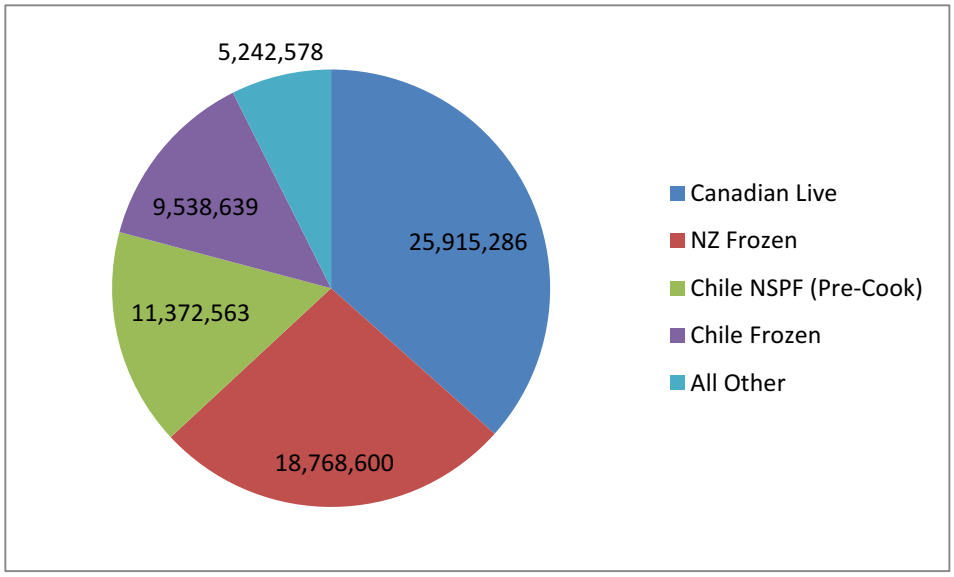

Figure 24. Mussel imports (lbs.) in 2015. Source: The Hale Group research, ACCSP, Maine DMR

When all mussel formats and sources are accounted for, the U.S. mussels category is approximately 100 million pounds and is valued at approximately $150 million. U.S. live mussels represent one-third of the overall U.S. market. Live mussels in total represent almost 60% of U.S. mussel volume (Table 18).

Table 18. 2015 US mussel marketplace origin summary data

Origin	Format	Volume – Lbs. (000)	Value $(000)	Avg. $ / Lb.	Volume Share
Domestic	Live	34,577	$35,155	$1.02	33%
Canada	Live	25,915	$33,138	$1.28	25%
Total Live Mussels		**60,492**	**$68,293**	**$1.13**	**58%**
New Zealand	Frozen	18,768	$46,347	$2.47	18%
Chile Frozen	Frozen	9,539	$11,745	$1.23	9%
Total Frozen Mussels		**28,307**	**$58,092**	**$2.05**	**27%**
Chile NSPF (Pre-Cooked)	Frozen / Canned?	11,373	$13,534	$1.19	11%
All Other	Misc.	5,243	$8,815	$1.68	5%
Total Mussels		**105,415**	**$148,734**	**$1.41**	**100.0%**

Source: NMFS, The Hale Group research

iii. Impact of Canadian Imports on Maine

THG's research indicates that Canadian mussels are distributed across the United States, although penetration is highest in the Northern half of the country, which is closest to the source. Frozen mussels imported from New Zealand and Chile tend to have higher consumption patterns in the Southern and Western states. Estimates for the regional penetration of Canadian live mussel imports are as follows (Table 19):

Table 19. Estimated Canadian mussel regional distribution within the US marketplace (2015)

Region	% U.S. Population	% Shellfish Consumption	Est. % Canadian Mussel Consumption	Est. Canadian Mussel Whole Lbs. (000)
North East / Mid Atl.	18%	20%	35%	9,070
Central	21%	19%	23%	5,960
South	37%	43%	20%	5,183
West	24%	18%	22%	5,701
Total	100%	100%	100%	25,915

Source: The Hale Group research, Agriculture and Agri-Food Canada

The estimated 9 million pounds of PEI mussels consumed in the Northeast and Mid-Atlantic states represent an opportunity for Maine mussels to further penetrate close proximity markets.

iv. Whole Versus Shucked / Further Processed Formats

As noted in the Imports – All formats section, whole mussels, either live or frozen represent approximately 85% of total U.S. consumption. Much of the shucked / further processed product is typically sourced from Chile, which has low cost operations and dominates this market niche.

v. Seasonality

Wholesalers and foodservice operators report minimal seasonality with mussel demand, nor do they experience significant supply seasonality. As with oysters, seasonality is primarily a harvest-related issue in cold water climates rather than a demand-driven issue.

On the west coast, mussel farmers often produce two different mussels to mitigate the impact of spawning, as the mussels spawn at different times of the year; Mediterranean (*Mytilus galloprovincialis*) in the winter and Blue in the summer.

In general, consumer demand is at its peak during the summer months and Holidays.

vi. Growth Projections - National

The total live mussel marketplace is projected to continue to expand at a modest pace, with moderate growth from imports, and is expected to approach 80 million whole pounds by the end of the planning horizon. Northeast mussels, including Maine, are projected to grow faster than the industry average given their high quality perception and expected capacity increases. The key assumption for Northeast mussel growth is that sufficient Maine farmed capacity will be added to offset projected declines in wild stock and enable overall growth. Also within the Northeast, Massachusetts wild production is projected to increase in the short term as new growth areas are brought to market.

Mussel growth is projected to be driven by a combination of both increased supply and continued growth in demand. Demand drivers include:

- Population growth of approximately 0.8% annually
- "Halo" effect benefit of oyster growth on restaurant menus and the corresponding increased interest in shellfish; which was reported by numerous chefs and foodservice operators during the research
- Superior quality of Northeast mussels relative to PEI product

Based on best estimate supply and demand projections, total mussel supply will marginally outpace demand over the planning horizon (Figure 25). The primary supply & demand assumptions include supply growth in all primary markets at the following levels (Table 20):

Table 20. Mussel regional supply growth projections. Source: The Hale Group research, ACCSP, Maine DMR

Region	Current Supply Pounds (000)	Annual Capacity Growth			Proj. 2030 Supply Pounds (000)
		2015 - 2020	2021 - 2025	2026 - 2030	
Maine					
Farmed	1,350	14.0%	17.0%	13.0%	10,500
Wild	13,110	-0.5%	-0.5%	-0.5%	12,160
Total	14,460	1.0%	2.9%	4.0%	21,105
Massachusetts					
Farmed	80	10.0%	9.9%	5.1%	265
Wild	8,150	4.0%	1.0%	0.0%	10,396
Total	8,230	4.0%	1.1%	0.1%	10,661
Pac NW					
Farmed	4,000	3.0%	2.5%	1.0%	5,514
Wild	7,887	0.5%	0.3%	0.0%	8,208
Total	11,887	1.4%	1.1%	0.4%	13,722
U.S. Total					
Farmed	5,430	*5.9%*	*8.1%*	*7.4%*	*14,723*
Wild	29,147	*1.1%*	*0.2%*	*-0.2%*	*30,765*
Total	34,577	*1.9%*	*1.9%*	*1.9%*	*45,488*
Canada					
Farmed	23,300	1.9%	1.0%	0.5%	27,556
Wild	2,615	0.0%	0.8%	0.5%	3,074
Total	25,915	1.9%	1.0%	0.5%	30,630
Total U.S. Live Supply					
Farmed	28,730	2.7%	2.7%	2.6%	42,279
Wild	31,762	1.2%	0.3%	-0.1%	33,839
Total	**60,492**	**1.9%**	**1.5%**	**1.3%**	**76,118**

Note: Growth projections are based on analysis of anticipated future demand and supply growth dynamics; not derived from past growth trends.

Table 21. Mussel supply growth assumptions

Assumptions	
Maine:	Minimal new lease applications in process (7 + acres), yet incremental capacity at existing lease sites
	Assume -0.5% annual decline in Wild supply
	Strong Aquaculture growth off relatively small base (+14% / yr. '15-'20; +17% / yr. '20-'25; +13% / yr. '25-'30
Massachusetts	Short term capacity gain from new Wild sites
	Relatively low growth in mid-to-long term due to location expansion constraints
Pac NW	Assume continued capacity constraints; limited growth (+1% - 2%)
Canada	Short term recovery from winter of 2014 / 2015
	Capacity constraints over long term

Demand assumptions: Marginal increase in demand from 0.19 lbs. / per capita to 0.21 lbs. / capita based on anticipated continued expanded consumer interest in shellfish and the growth of high quality Northeast mussels.

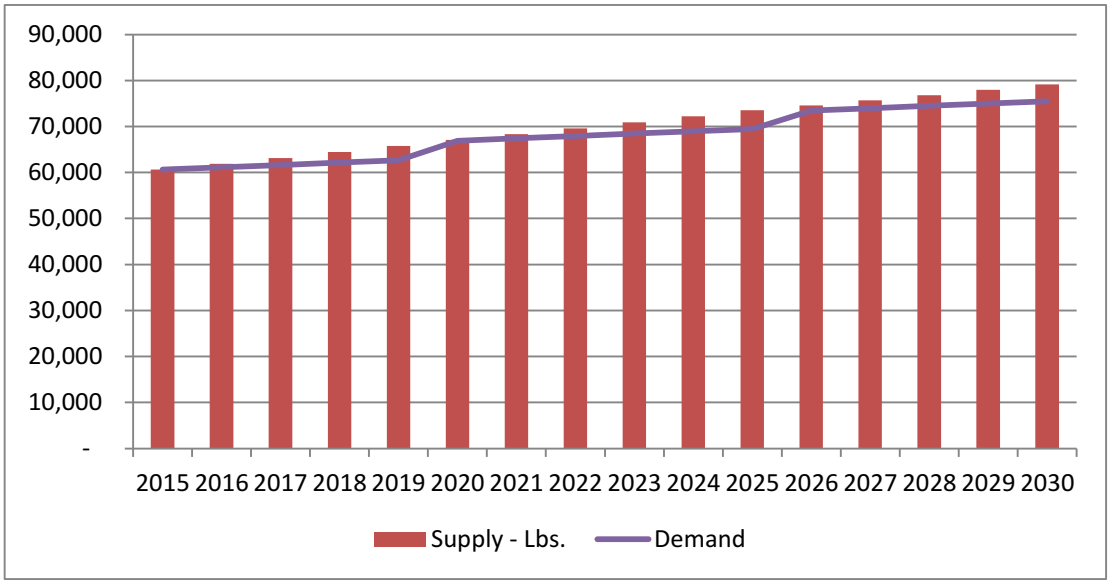

Figure 25. Live mussel supply and demand projections for the total U.S. marketplace. Source. The Hale Group research. Note: The total U.S. supply includes Canadian-sourced live mussels.

In total, the supply of mussels including both wild and farmed sourcing is projected to grow by approximately 16 million pounds over the planning horizon (Figure 26). Farmed mussels are projected to account for almost 90% of the total growth, with over one-half of the incremental farmed mussel volume sourced from Maine assuming that farmed capacity is added in the state (Figure 27).

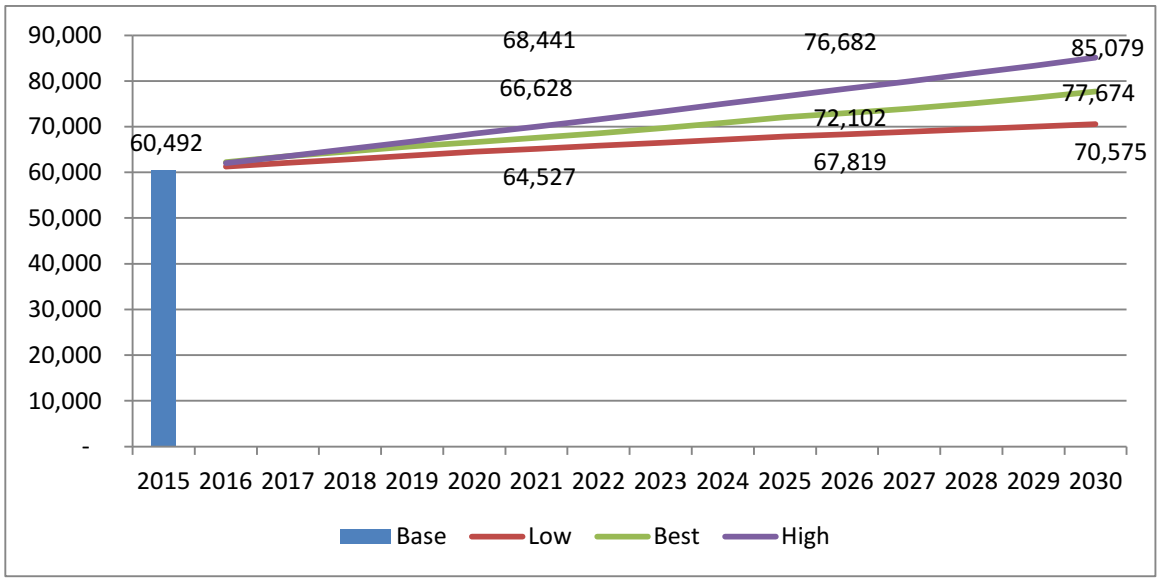

Figure 26. Projected live mussel volume growth (000 lbs.). Source. The Hale Group research, ACCSP, Maine DMR, Statistics Canada. Note: The total U.S. supply includes Canadian-sourced live mussels.

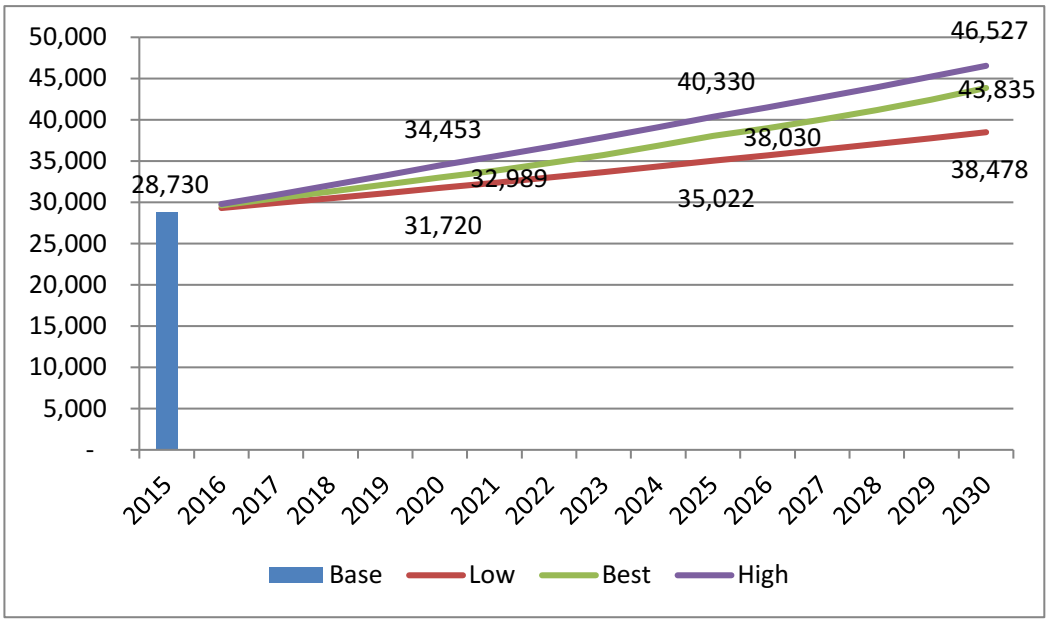

Figure 27. Projected farmed mussel volume growth in US Marketplace (000 lbs.). Note: The total U.S. supply includes Canadian-sourced live mussels.

Given its cold water environment and available capacity, Maine is projected to be a growth leader in farmed mussel production assuming that the aquaculture base is expanded (Table 22). Over the planning horizon, it is projected that the Northeast farmed mussels will capture approximately 20 share points from Canada and the Pac NW. Canadian mussels are expected to realize only moderate growth given capacity constraints in PEI and the relatively under-developed mussel aquaculture industry in adjoining areas. Should the adjoining Canadian provinces (Nova Scotia, Newfoundland, etc.) develop a logistics infrastructure to cost-effectively

and efficiently support shellfish aquaculture exports to the U.S., then the supply of lower priced Canadian mussels could expand. To-date, this infrastructure is lacking in Canada.

The research indicates that there is an opportunity for Maine's mussel farmers to take market share from Canada. Accomplishing this will require:

- Ensuring consistency of supply from Maine
- Defining the value proposition and branding strategy, as Maine harvesters will be competing against a well-entrenched competitor
- Consideration of the potential impact on pricing; potentially impacted by both exchange rates and subsidy levels

Table 22. Projected volume growth of U.S. farmed mussel supply (000 lbs.). Source. The Hale Group research, ACCSP, Maine DMR

Region	2015 Volume (000)	Proj. Annual % Chg. '15 – '20	Best Proj. 2020 Vol. (000)	Proj. Annual % Chg. '20 – '25	Best Proj. 2025 Vol. (000)	Proj. Annual % Chg. '25 – '30	Best Proj. 2030 Vol. (000)
Maine	**1,350**	**14.0%**	**2,599**	**17.0%**	**5,699**	**13.0%**	**10,500**
Mass.	80	10.0%	129	9.9%	207	5.1%	265
PacNW	4,000	3.0%	4,637	2.5%	5,246	1.0%	5,514
Total U.S. Regions	5,430	6.3%	7,365	8.7%	11,153	7.9%	16,279
Canada	23,300	1.9%	25,624	1.0%	26,877	0.5%	27,556
Total Farmed	**28,730**	**2.8%**	**32,989**	**2.9%**	**38,030**	**2.9%**	**43,835**

In total, mussel pricing is projected to remain essentially flat as supply and demand are projected to remain relatively well balanced. When comparing ACCSP data for landed meat pounds relative to the value per pound of mussel landings, the R Square correlation metric of .32 indicates negligible correlation between volume and price (Table 23).

Table 23. Historical mussel regression analysis: meat pounds vs. pricing

Year	Landed Meat Lbs.	$ / Lb	Summary Output	
2005	6,393,581	$ 0.42	*Regression Statistics*	
2006	6,627,344	$ 0.45	Multiple R	0.567538718
2007	2,948,461	$ 0.76	R Square	0.322100197
2008	3,241,089	$ 0.74	Adjusted R Square	0.237362721
2009	3,379,811	$ 0.76	Standard Error	1109666.215
2010	3,163,157	$ 0.82	Observations	10
2011	3,460,367	$ 0.73		
2012	2,845,534	$ 0.89		
2013	3,436,193	$ 1.12		
2014	3,404,180	$ 1.08		
2015	5,699,154	$ 0.79		

Source: ACCSP data

Mussel pricing is expected to remain relatively consistent (Figure 28). It is expected that, in the short term, Maine's average mussel pricing will increase as the higher priced aquaculture mussel industry expands. Pricing scenarios assume that pricing will begin to moderate at the end of the planning horizon, as domestic farmed mussels compete with PEI mussels for market share.

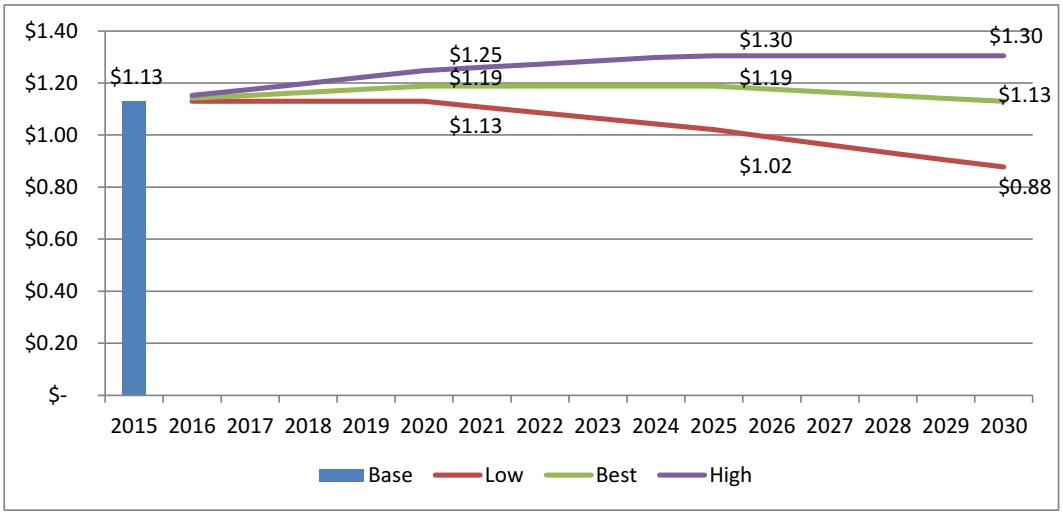

Figure 28. Projected average U.S. mussel price per pound (ex-vessel). Source: The Hale Group research

Based on the research findings, the total landed value of the live mussel marketplace in the U.S. is projected to approach $90 million by 2030 (Figure 29).

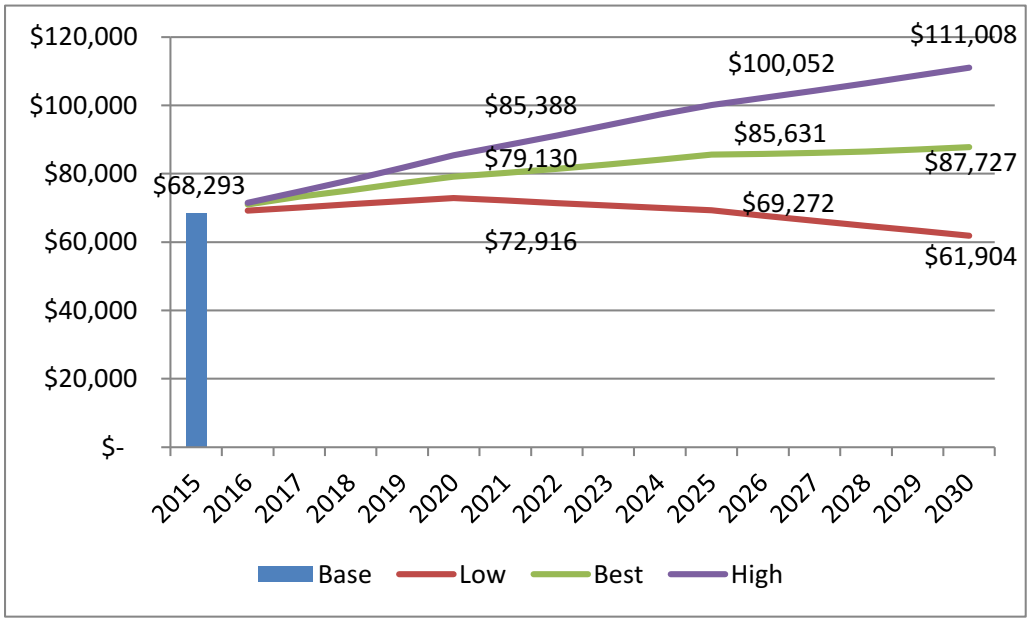

Figure 29. Projected total U.S. marketplace live mussel landed value (000 $USD). Source: The Hale Group research, ECSGA, ACCSP, GSMFC. Note: Includes Canadian-sourced live mussels.

When evaluating the projected future relationship between mussel supply and pricing, there is minimal correlation between volume (supply) and pricing as supply is eventually projected to catch up to demand (Table 24).

Table 24. Mussel future regression analysis: projected pounds vs. pricing. Total U.S. supply (including Canadian imports). All Mussel formats and landings. Source: The Hale Group research

Year	Proj. Pounds	$ / Lb.
2015	60,492	$ 1.15
2016	62,018	$ 1.16
2017	63,288	$ 1.17
2018	64,285	$ 1.18
2019	65,329	$ 1.20
2020	66,243	$ 1.21
2021	67,092	$ 1.21
2022	68,008	$ 1.21
2023	69,008	$ 1.21
2024	70,104	$ 1.21
2025	71,258	$ 1.21
2026	72,039	$ 1.20
2027	72,904	$ 1.18
2028	73,864	$ 1.17
2029	74,931	$ 1.16
2030	76,118	$ 1.15

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.202938971
R Square	*0.041184226*
Adjusted R Square	-0.032570833
Standard Error	4458.049804
Observations	15

vii. Growth Projections - Maine

Assuming that Maine expands its aquaculture capacity, the state is positioned to be a growth leader in the live mussel industry given its available capacity, high quality growing environment and brand equity. Maine's strong brand equity and positive imagery were cited repeatedly during the research by supply chain participants across the country. There appears to be a clear opportunity to leverage this brand equity to support any expansion of the Maine farmed shellfish industry.

Mid-point estimates project that Maine's farmed mussel industry can grow approximately six-fold over the planning horizon as the overall market expands modestly, wild supply is constrained and Maine farmed competes with PEI for market share (Figure 30).

To meet the projected increase in demand, Maine mussel aquaculture will need to add an additional 90 – 100 acres over the planning horizon, assuming that current leases are capacity constrained. This equates to approximately 6 – 7 additional lease acres annually over the planning horizon.

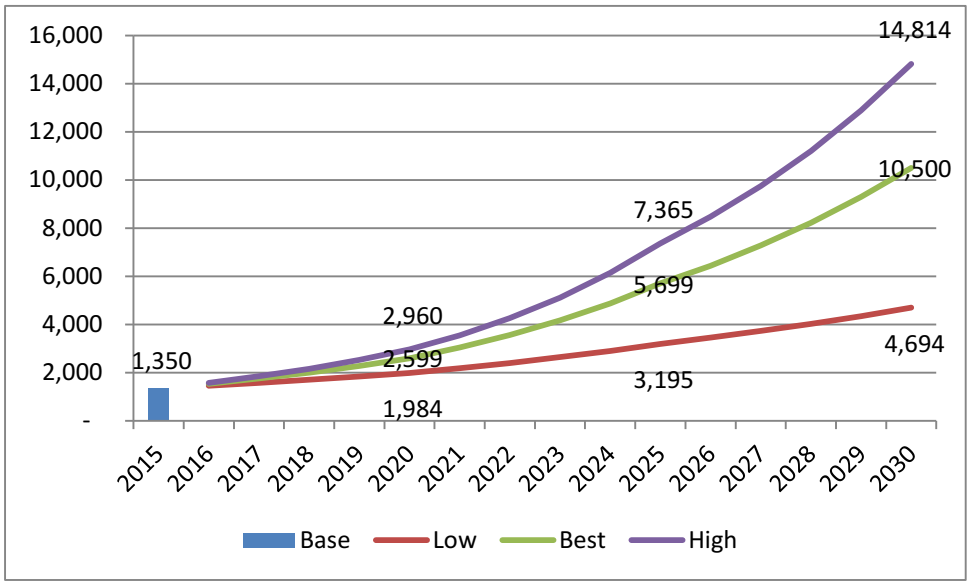

Figure 30. Projected growth volume of Maine farmed mussels (000 lbs.) 2015 - 2030. Source: The Hale Group research

Given that rope-grown mussel harvesting has greater yield per acre and commands a higher price than bottom-culture, the assumption is that rope-grown will account for approximately 80% of Maine's farmed mussel growth over the planning horizon (Figure 31).

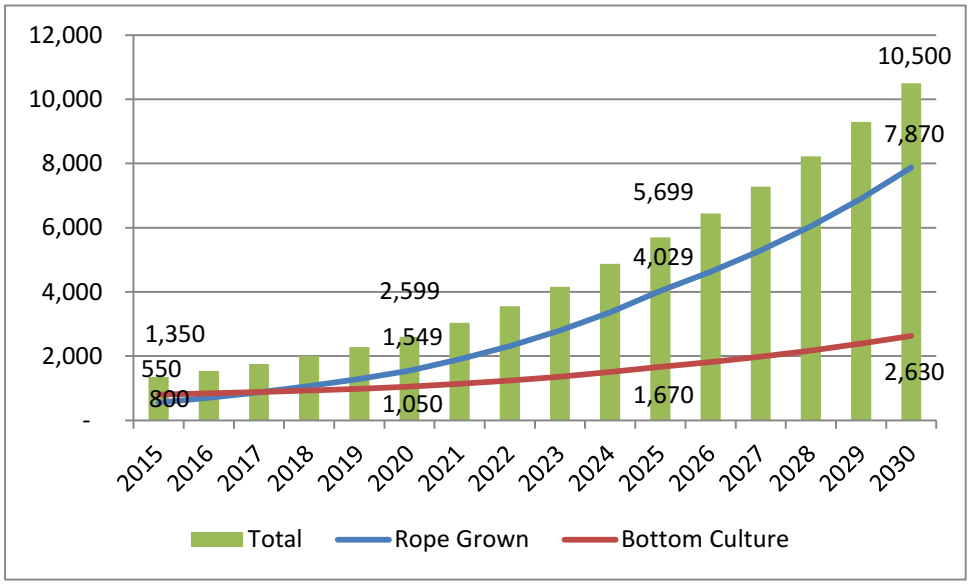

Figure 31. Projected growth volume of Maine farmed mussels – Rope-grown vs. bottom-culture (000 lbs.) 2015 - 2030. Source: The Hale Group research

Pricing scenarios assume that the Maine farmed mussel volume mix will evolve with the previously referenced volumetric growth projections for rope-grown and bottom-culture techniques.

Pricing projections assume that Maine farmed mussels will continue to command a price premium relative to PEI mussels given their higher perceived quality. The pricing projections also assume that Maine farmed mussel pricing will moderate approximately -10% (in 2015 real dollars) over the planning horizon as farmed capacity expands and Maine mussel farmers compete directly with Canadian imports for market share.

While the average price per pound within each Maine mussel harvest format (rope-grown, bottom culture, wild caught) is projected to decline over the planning horizon, the average price per pound is projected to increase, as higher price farmed mussels build share while lower value wild mussels decline (Figure 32).

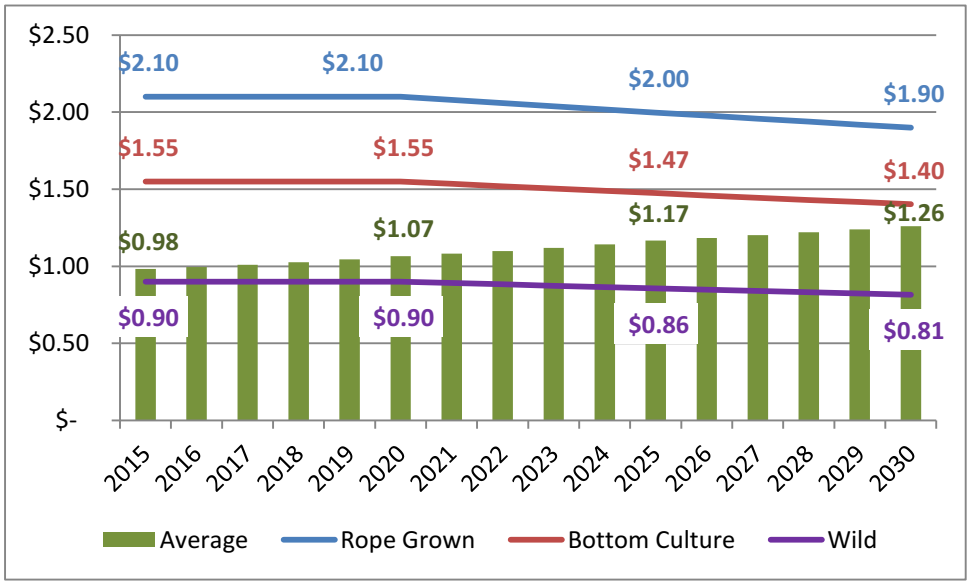

Figure 32. Projected average Maine mussel price per pound (ex-vessel value) under the best estimate scenario 2015 - 2030. Source: The Hale Group research

Based on the volume and landed pricing research, the total value of Maine farmed mussels is projected to reach approximately $20 million by 2030 (Figure 33).

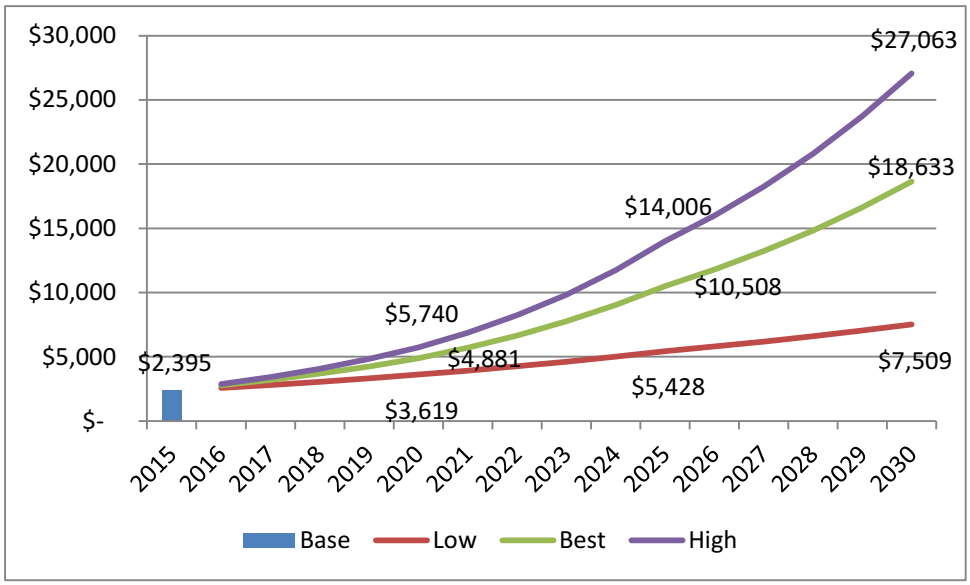

Figure 33. Projected total landed value of Maine farmed mussels ($USD) 2015 - 2030. Source: The Hale Group research

In total, including both farmed and wild sourcing, Maine's mussel harvest is projected to approximately double in landed value to almost $30 million by 2030. Based on growth projections, Maine's farmed mussel value will surpass wild during the last five years of the planning horizon (Figure 34).

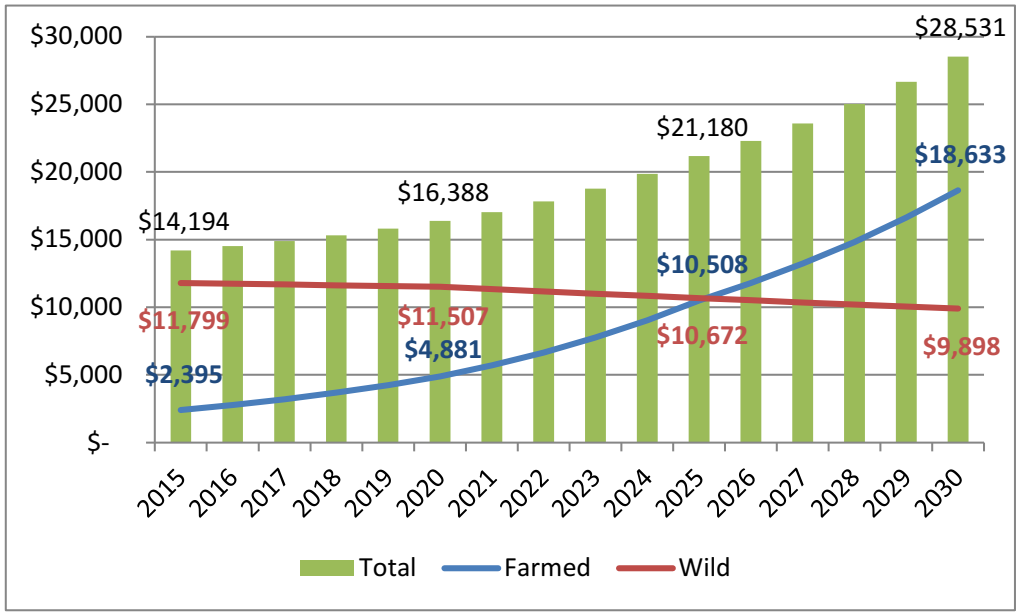

Figure 34. Projected total Maine mussel revenue 2015 - 2030. (best estimate scenario). Source: The Hale Group research

By the end of the planning horizon, Maine farmed rope-grown mussels are projected to deliver approximately $15 million in landed value, while farmed bottom-culture mussels are projected to account for almost $4 million (Figure 35).

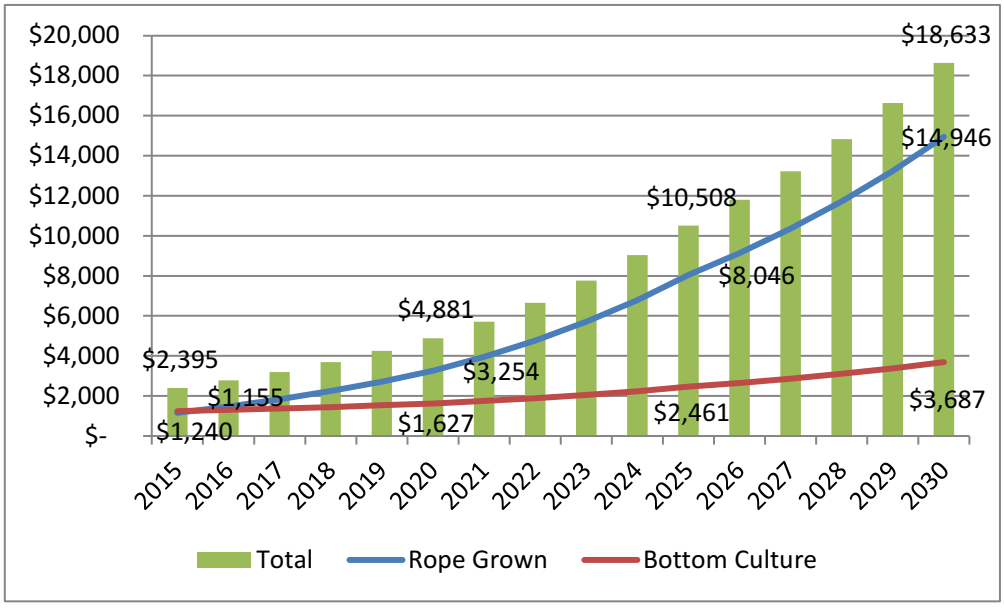

Figure 35. Projected Maine farmed mussel revenue 2015 - 2030 (best estimate scenario). Source: The Hale Group research

SEA SCALLOP

(Placopecten magellanicus)

i. Species Overview

The U.S. scallop industry has a much less developed aquaculture infrastructure and less data than exists for the oyster and mussel sectors; so this section relies more on qualitative research and assumptions, which are identified throughout. The scallop growth projections identified in the report assume development of a scallop aquaculture infrastructure in Maine. Without which, the supply projections will be difficult to attain.

The U.S. scallop market, which represents an approximately $380 million landed value, has declined in recent years due to reductions in the Federal quotas that are used to manage the scallop biomass at sustainable levels. The reduction in offshore supply has led to an increased interest in local day-boat scallops, which may serve as a proxy for potential interest in farmed scallops. Per the Maine DMR, the large majority (90+%) of Maine scallop landings are day-boat, or in-shore.

Given the imbalance between supply and demand, scallop prices have been at or near record levels recently. While pricing is anticipated to remain relatively high based on historical levels, prices are expected to begin to moderate over the planning horizon.

Despite strong consumer demand and shrinking supply, aquaculture initiatives have not yet gained scale in the scallop market. There is broad consensus that the scallop market is well suited for aquaculture. There is also recognition that farmed scallop techniques need to be tested and optimized before sufficient scale can be achieved. Developing these capabilities and supporting the testing requirements for Scallops, will require an investment in time and resources to achieve sufficient scale.

There is a large import market for smaller scallops, primarily from China, Japan and Argentina. These frozen products represent an additional $350 million in value.

Similar to the other shellfish species, there is broad consensus that Maine-branded scallops command a premium due to their high quality and the positive associations with Maine. Additionally, since the majority of Maine scallops are day-boat sourced, there is a perception of higher quality among some restaurant operators and wholesalers / distributors relative to some of the off-shore scallops that are landed at other New England states.

ii. Market Size and Growth

The total U.S. scallop marketplace is estimated to be approximately 250 million whole pounds and 30 million meat pounds (Figure 36), with a landed value of approximately $380 million (Table 25). In the U.S., the majority of scallops are sourced from Massachusetts and New Jersey.

The U.S. scallop supply has declined as federal quotas have restricted offshore access and larger day boat scallops are reportedly becoming scarcer.

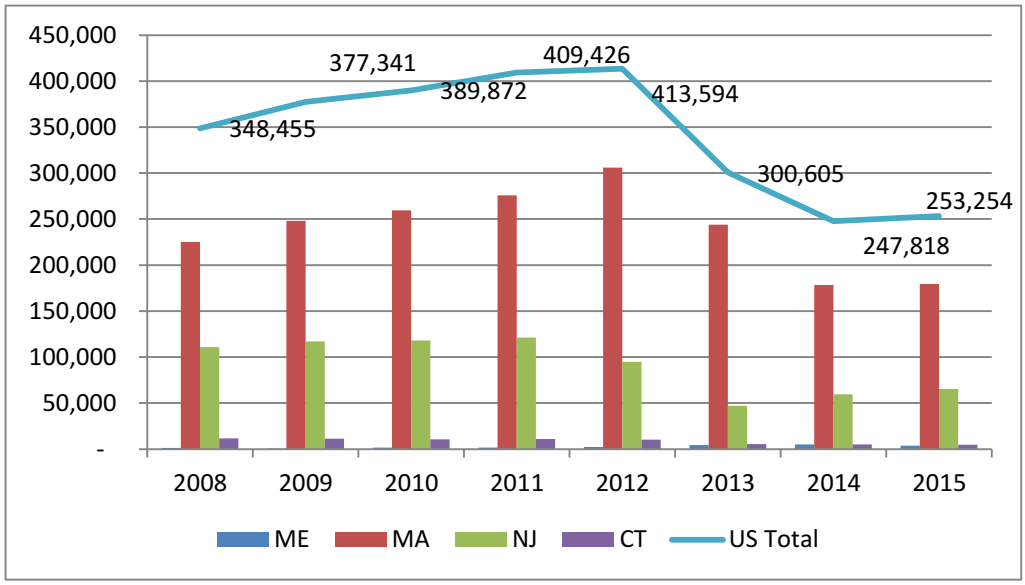

Figure 36. US scallop supply volume trends in whole pounds (000) 2008 - 2015. Source: The Hale Group research, Maine DMR, ACCSP

In total, Maine accounts for less than 2% of scallop volume, yet commands the highest average price per meat pound (Table 25). Per the Maine DMR, the vast majority (90+%) of Maine scallops are from inshore fisheries harvested via day-boat operations.

Table 25. Scallop regional supply dynamics in 2015

State	Volume – Whole Lbs. (000)	Volume – Meat Lbs. (000)	Value - $USD (000)	Value Per Meat Pound
Maine	3,772	452	$5,749	$12.70
Massachusetts	179,297	21,522	$264,941	$12.31
New Jersey	65,393	7,847	$97,856	$12.47
Connecticut	4,803	576	$7,032	$12.20
Grand Total	**253,266**	**30,397**	**$375,579**	**$12.36**

Source: The Hale Group research, Maine DMR, ACCSP

iii. Imports – All Formats

A significant volume of smaller, frozen scallops are imported, primarily from Asia and South America (Figure 37). China is the volume leader, while Japan imports have the greatest value. In total, U.S. scallop imports exceed 40 million pounds with a value of $350 MM, almost equaling U.S.-produced value (Figure 38).

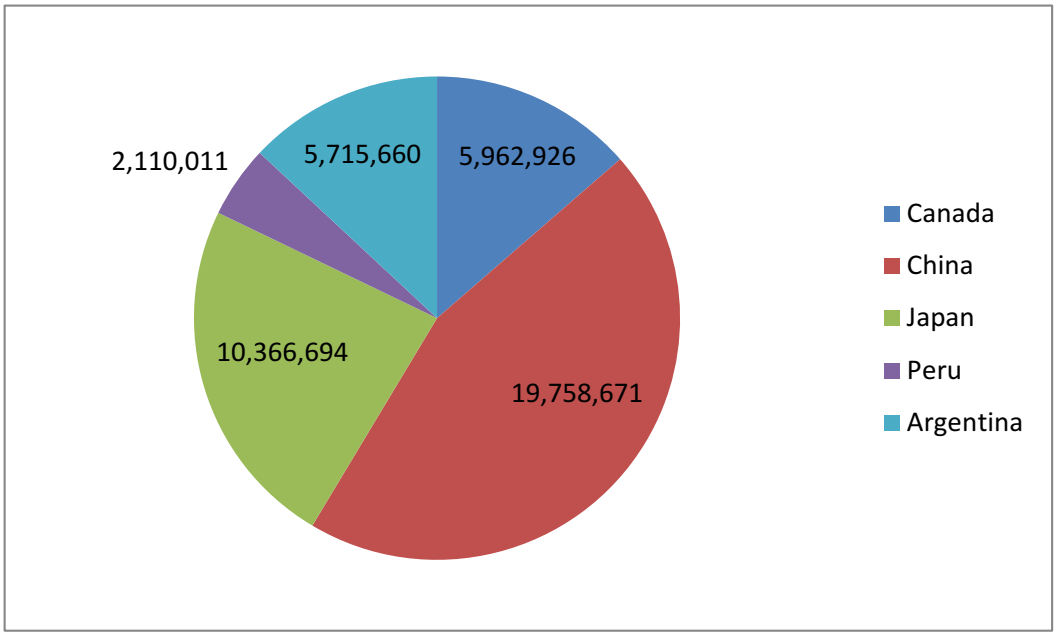

Figure 37. US marketplace scallop imports for 2015 in meat pounds (000). Source: The Hale Group research, NMFS

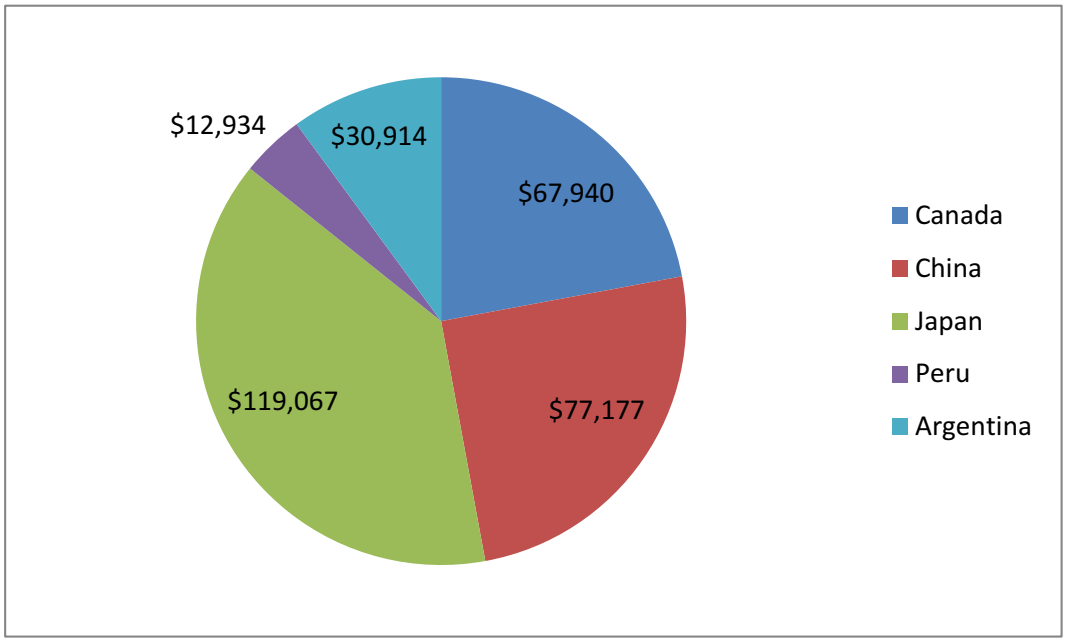

Figure 38. Value of imported scallops in the US marketplace for 2015 (000$). Source: The Hale Group research, NMFS

iv. Seasonality

Scallop demand remains strong year-round, while supply tends to peak during the early periods of the harvesting seasons

- Maine: December – April
- Massachusetts: November - March
- Federal: March - February

All research findings support the hypothesis that there is an opportunity for farmed scallops to support wild harvest by providing year-round inventory after wild scallop harvest inventory has been diminished. Given the strong demand for Maine's in-shore scallops and accompanying high pricing, this suggests that Maine farmed scallops could be a viable source for high-quality scallops during lulls in the wild fishery.

v. Quota Projections

The marine resource agencies in Massachusetts and Maine believe that Federal quotas, while difficult to predict, will remain essentially flat for the next few years as the biomass is carefully managed. There is no expectation that overall scallop capacity will increase significantly in the near-to-medium term. Research respondents were not able to provide long term projections given the uncertainty of the scallop biomass status.

It is The Hale Group's position that scallop demand will continue to outstrip supply until either an aquaculture infrastructure is developed to significantly increase supply, or pricing reaches a point where restaurant operators and consumers switch to other seafood proteins and demand falls to levels below supply capacity. There is no evidence of scallop demand beginning to soften from current levels.

vi. Growth Projections - National

Unless there are unforeseen increases in scallop quotas or rapid development of an aquaculture infrastructure, the scallop supply is projected to remain flat to slightly down (Low growth scenario).

Given the demand for scallops and high market prices, the mid-point and high growth scenarios assume that a scallop aquaculture industry will be developed over the next 3 – 5 years, and will begin to gain market share over the mid and end stages of the planning horizon. Given its growing environment and theoretical capacity, it is assumed that Maine will be the leader in scallop aquaculture if it is to be developed in the U.S.

Based on best estimate supply and demand projections, scallop supply is projected to significantly lag demand over the planning horizon. As a benchmark of recent demand, U.S. per capita scallop consumption was 19 lbs. / 100 people in 2011 and dropped to 11 lbs. / 100 people

by 2015 due to supply constraints. The primary Supply & Demand assumptions include supply growth in all primary markets at the following levels (Table 26).

Table 26. Scallop Regional Growth Rate Projections. Source: The Hale Group research, ACCSP, Maine DMR

Region	Current Supply Meat Pounds (000)	Annual Capacity Growth			Proj. 2030 Supply Pounds (000)
		2015 - 2020	2021 - 2025	2026 - 2030	
Maine	453	2.0%	8.0%	10.0%	1,183
Massachusetts	21,522	0.5%	0.5%	0.5%	23,194
New Jersey	7,847	0.5%	0.5%	0.5%	8,456
Connecticut	576	0.5%	0.5%	0.5%	621
Total	**30,398**	**2.0%**	**2.2%**	**2.6%**	**33,454**

Note: Growth projections are based on analysis of anticipated future demand and supply growth dynamics; not derived from past growth trends.

Table 27. Scallop Supply Growth Assumptions

Assumptions		
Maine:	Development of aquaculture capabilities by mid-point of planning horizon	
	Modest +0.5% annual growth in current supply biomass (primarily in-shore locations)	
Rest North East	Modest +0.5% annual growth in current off-shore biomass and federal quotas	
	Minimal aquaculture development due to warmer water and lack of capacity	

- Demand: If base demand is set at 2011 per capita consumption levels, and federal quotas increase at a modest +0.5% annually, then domestic supply will not catch up to demand over the planning horizon. Imported scallops will continue to be required to meet overall demand. The majority of imported scallops lack the size, quality, flavor and consistency of domestically-sourced scallops, so demand for domestic scallops is projected to remain strong throughout the planning horizon. Total domestic supply will need to more than double to meet projected demand (Figure 39 & 40).

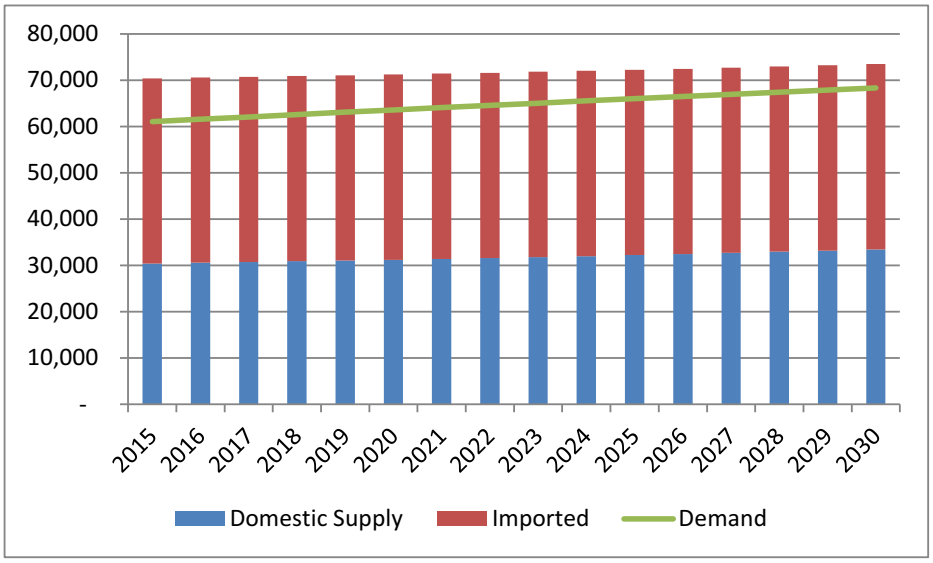

Figure 39. US marketplace scallop supply and demand projections 2015 – 2030. Source: The Hale Group research, ACCSP, Maine DMR

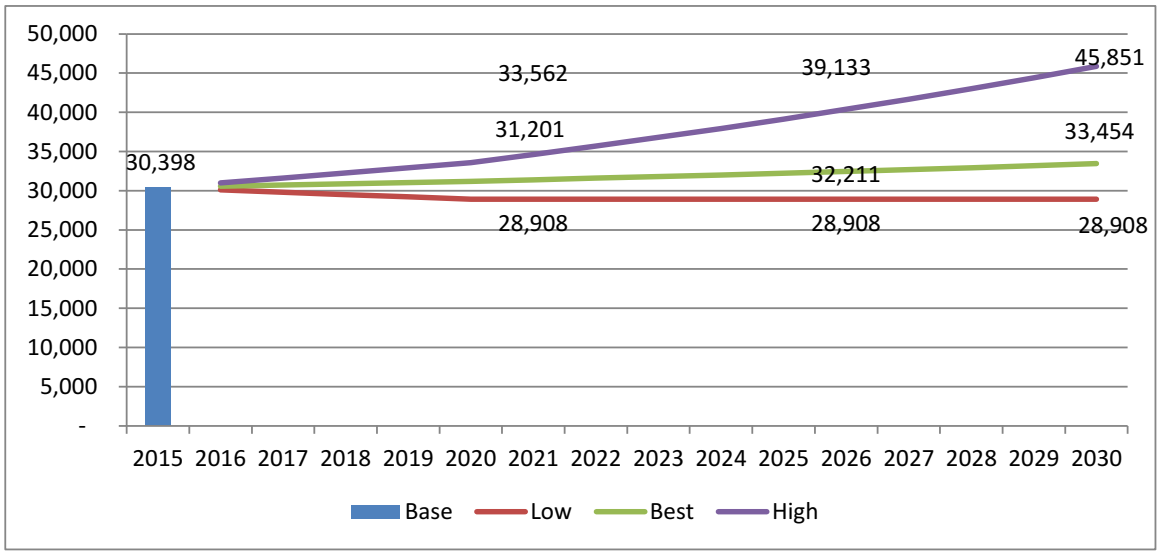

Figure 40. Projected domestic-sourced scallop volume growth in meat pounds (000) 2015 - 2030. Source: The Hale Group research, ACCSP, Maine DMR

Maine is particularly well-suited for scallop aquaculture growth, given the significant room for new sites and existing perception that Maine's wild scallops are high quality. The mid-point (best) scenario assumes that Maine will be a participant in the development of a scallop aquaculture industry. The mid-point scenario, with the assumption of an aquaculture infrastructure, will enable Maine to more than double its scallop volume over the planning horizon, with rapid acceleration at the end of the planning cycle as farmed scallop capacity is expanded (Table 28). This scenario will return Maine scallop production to levels comparable to the early 1990's.

Table 28. Regional scallop growth projections

Region	2015 Volume Meat Lbs. (000)	Proj. Annual % Chg. '15 – '20	Best Proj. 2020 Vol. (000)	Proj. Annual % Chg. '20 – '25	Best Proj. 2025 Vol. (000)	Proj. Annual % Chg. '25 – '30	Best Proj. 2030 Vol. (000)
Maine	**453**	**2%**	**500**	**8%**	**734**	**10%**	**1,183**
Mass.	21,522	0.5%	22,065	0.5%	22,623	0.5%	23,194
New Jersey	7,847	0.5%	8,045	0.5%	8,248	0.5%	8,457
Conn.	576	0.5%	591	0.5%	605	0.5%	621
Grand Total	**30,398**	**0.5%**	**31,201**	**0.6%**	**32,211**	**0.8%**	**33,454**

Source: The Hale Group research, Maine DMR, ACCSP

When comparing ACCSP data for landed meat pounds relative to the value per pound of scallop landings, the R Square correlation metric of .72 indicates that there is moderate correlation between supply and pricing (Table 29). This is not surprising given the fact that pricing has increased as volume (supply) declined in recent years.

Table 29. Historical scallop regression analysis output, meat lbs. vs. pricing, 2005 – 2015.

Year	Landed Meat Lbs.	$ / Lb
2005	57,166,354	$ 7.51
2006	60,308,277	$ 6.43
2007	58,312,844	$ 6.61
2008	53,306,094	$ 6.93
2009	57,517,297	$ 6.48
2010	56,962,729	$ 7.91
2011	58,719,355	$ 9.89
2012	56,836,993	$ 9.83
2013	40,989,144	$ 11.39
2014	33,677,973	$ 12.52
2015	35,591,778	$ 12.32

SUMMARY OUTPUT	
Regression Statistics	
Multiple R	0.847071349
R Square	0.717529871
Adjusted R Square	0.682221105
Standard Error	5804805.218
Observations	10

Source: ACCSP data

Scallop pricing is projected to decline moderately over the planning horizon. The higher quality Maine scallops should be able to maintain a premium, but all prices are expected to soften from current levels (Figure 41).

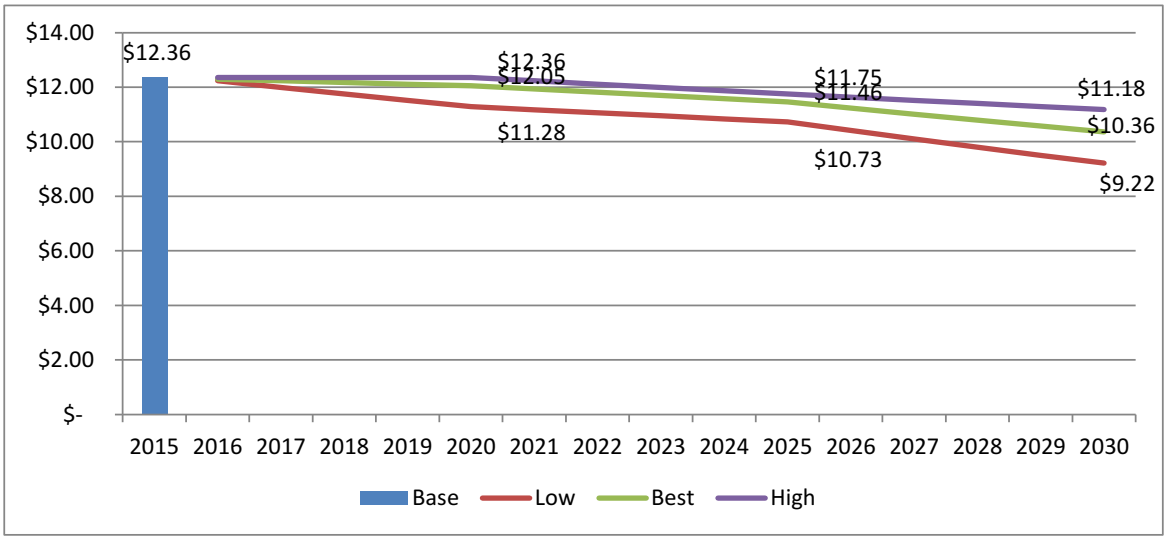

Figure 41. Projected U.S. scallop price per meat pound (ex-vessel value) 2015 - 2030. Source: The Hale Group research, Maine DMR, ACCSP.

Based on the research findings, the total landed value of the U.S. produced scallop marketplace in the U.S. is projected to fall to less than $350 million by 2030, assuming a softening in pricing and that federal quotas are not increased more than 0.5% per year (Figure 42). This projection assumes that Maine will develop a farmed scallop infrastructure over the planning horizon to offset some of the offshore capacity constraints. Without new aquaculture capacity, there is a risk of continued declines in total value if quotas remain flat-to-down and pricing moderates.

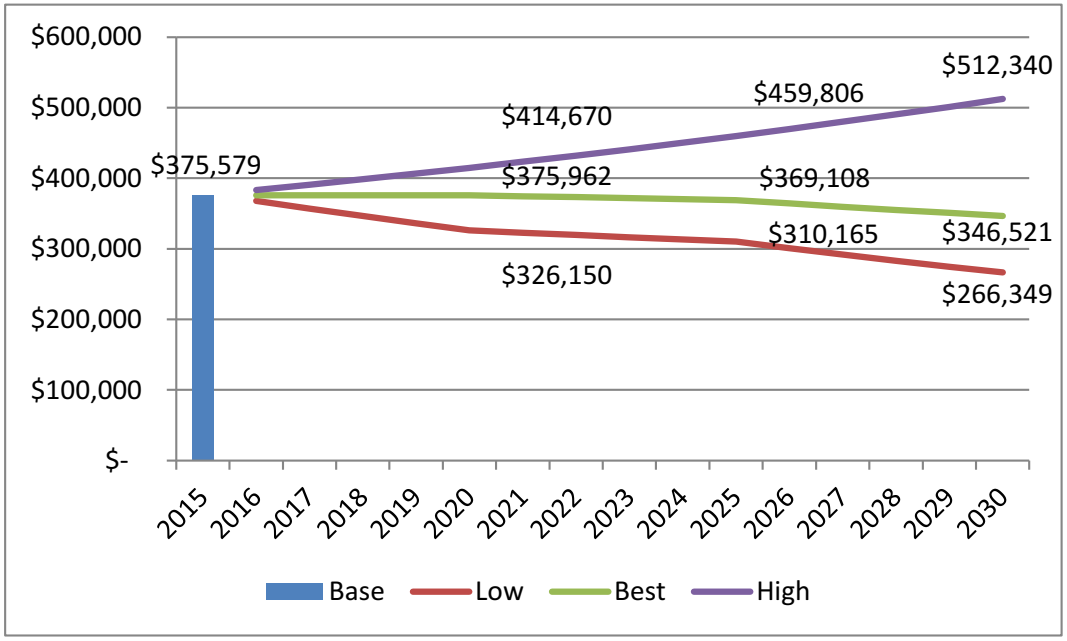

Figure 42. Projected scallop total landed value ($USD) 2015 - 2030. Source: The Hale Group research, ECSGA, ACCSP, GSMFC

When evaluating the projected future relationship between scallop supply and pricing, there a significant correlation between volume (supply) and pricing as pricing is eventually projected to soften as domestic supply recovers modestly (Table 30). As noted earlier, domestic supply is not projected to catch up with demand for the perceived higher quality domestic scallops over the planning horizon. The U.S. scallop marketplace will remain heavily dependent on imports.

Table 30. Future scallop regression analysis output: projected pounds vs pricing for total U.S 2015 - 2030. All Scallop Formats and Landings.

Year	Domestic Pounds	$ / Lb.
2015	30,398	$ 12.36
2016	30,557	$ 12.29
2017	30,717	$ 12.23
2018	30,877	$ 12.17
2019	31,039	$ 12.11
2020	31,201	$ 12.05
2021	31,395	$ 11.93
2022	31,592	$ 11.81
2023	31,794	$ 11.69
2024	32,000	$ 11.57
2025	32,211	$ 11.46
2026	32,442	$ 11.23
2027	32,681	$ 11.01
2028	32,929	$ 10.79
2029	33,186	$ 10.57
2030	33,454	$ 10.36

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.98975669
R Square	*0.979618306*
Adjusted R Square	0.978050483
Standard Error	136.9846675
Observations	15

vii. Growth Projections - Maine

As with other shellfish species, Maine is well positioned for growth within the scallop marketplace, if an aquaculture infrastructure is developed. As noted previously, mid-point estimates project that Maine's scallop industry can almost triple over the planning horizon (Figure 43). The low growth scenario assumes minimal aquaculture infrastructure and continued supply constraints.

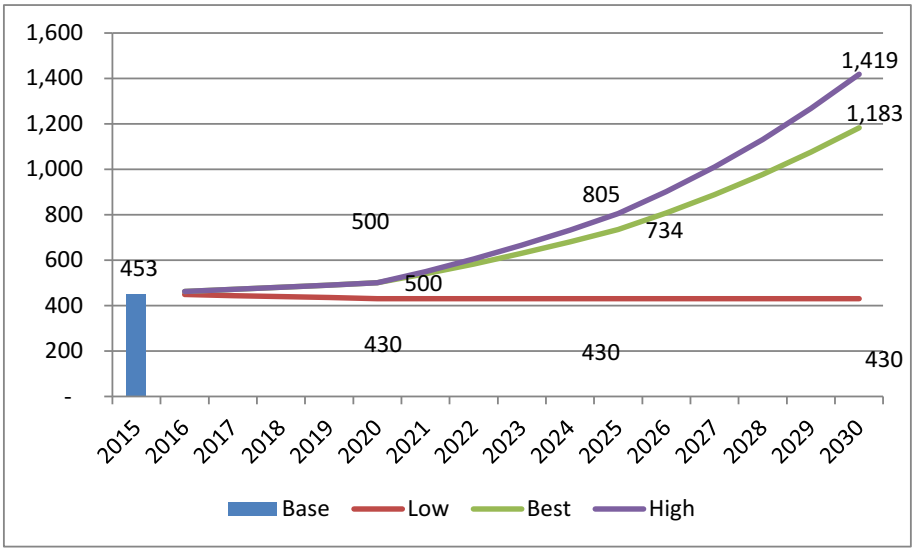

Figure 43. Projected Maine scallop volume growth in meat lbs. (000) 2015 - 2030. Source: The Hale Group research, Maine DMR

Pricing scenarios assume that Maine will continue to realize a price premium for Maine scallops, given their high perceived quality (Figure 44).

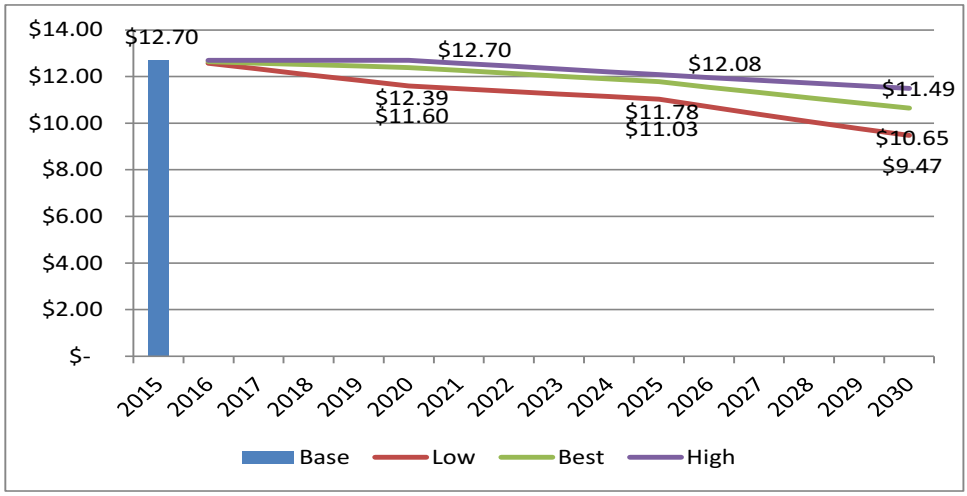

Figure 44. Projected average Maine scallop price per meat pound (ex-vessel). Source: The Hale Group research, Maine DMR

Based on the volume and landed pricing research, the total value of Maine scallops is projected to more than double to $12+ million by 2030 (Figure 45).

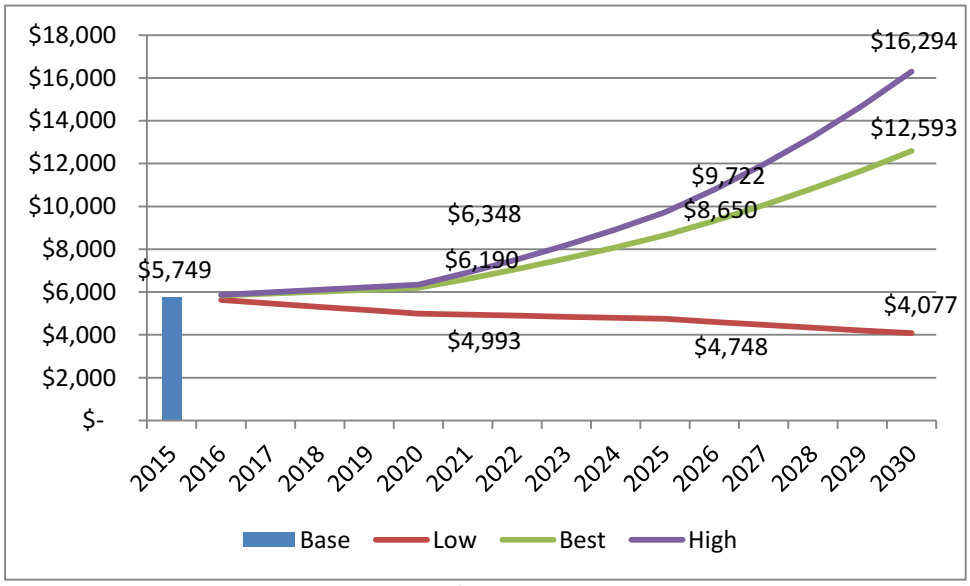

Figure 45. Projected Maine scallop total landed value ($USD) 2015 - 2030. Source: The Hale Group research, Maine DMR

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TOTAL ECONOMIC BENEFIT OF MAINE'S FARMED OYSTER AND MUSSEL SECTORS

At the request of the industry advisory committee, THG conducted a preliminary analysis of the economic benefit that the Maine farmed oysters and mussels bring to the state. The economic benefit analysis attempts to estimate the total value of Maine's farmed shellfish industry beyond just the landed product value. The broader economic benefit includes value that is added throughout the supply chain (wholesalers, distributors, restaurants, retailers, etc.) as well as ancillary value generated by the industry through capital expenditures, wages, operating expenses, insurance, etc.

The in-depth, Massachusetts Shellfish Aquaculture Economic Impact Study found that MA shellfish aquaculture generated an overall economic benefit to the state that was 1.8 X greater than the aquaculture output value. The broader economic value was generated by the ancillary elements of the aquaculture industry including:

- Employee compensation
- Equipment purchases and maintenance
- Supplies
- Insurance
- Leases
- Etc.

In the absence of a more detailed analysis in Maine similar to the Massachusetts analysis, THG evaluated the potential economic value generated by Maine farmed shellfish in the supply chain-only, which was not a focus of the Massachusetts study. The supply chain-only economic benefit to Maine is estimated to be approximately $10 million (Table 31).

Table 31. Estimated Maine farmed shellfish economic benefit

Economic Value Estimate	$ Value	% in Maine	Maine Incremental Economic Benefit
Ex-Vessel Output Value (All species)	$ 6,500,000		
Processing / Aggregating (approx. 18%)	$ 1,170,000	100%	$ 1,170,000
Wholesale / Distributor Purchases	$ 7,670,000		
Wholesale / Distributor Margin (approx. 12%)	$ 920,400	33%	$ 303,732
Restaurant / Retailer Purchases	$ 8,590,400		
Restaurant / Retailer Mark Up (80% FS@ 35% cost; 20% Retail@ 60% cost)	$ 21,476,000	10%	$ 2,147,600
Total Incremental Economic Value (Consumption / Supply Chain)			$ 3,621,332
Total Economic Benefit			**$ 10,121,332**

If the Massachusetts 1.8X factor for the other economic elements is applicable for Maine, then the non-supply chain economic benefit would be approximately $12 million (including the $6.5 million landed value). When combined with the supply chain economic benefits, **the total current economic benefit of farmed shellfish in Maine is estimated to exceed $15 million.**

OPPORTUNITY SUMMARY AND STRATEGIC IMPLICATIONS

The Farmed Shellfish Market Analysis identifies that there is significant opportunity for Maine to expand its farmed shellfish industry. Based on the "best estimate" projections, **the Maine farmed shellfish industry could achieve landed revenues in excess of $30 million by 2030.**

Table 32: Projected Maine farmed shellfish volume & revenue potential

Species	2015		2030 Proj.	
	Volume (000)	Landed Value (000)	Volume (000)	Landed Value (000)
Oysters	7,104 pc.	$4,121	18,629 pc.	$9,051
Mussels	1,350 lbs.	$2,395	10,500 lbs.	$18,633
Scallops	----	----	500+ meat lbs.	$5,000
Total ME Farmed Shellfish	**---**	**$6,516**	**---**	**$32,684**

Source: The Hale Group research

Achieving the business potential will require:

- Expansion of leased shellfish acreage from 608 to approximately 1,200 acres, which represents less than 0.3% of Maine's coast territorial waters, assuming that the majority of incremental mussel acreage utilizes rope-grown techniques
- Development of efficient distribution capabilities beyond New England to achieve scale and capture year-round demand for farmed shellfish in the top U.S. markets
- Investment in scallop aquaculture infrastructure and cold-water shellfish harvesting capabilities to extend the shellfish seasons
- Leveraging Maine's brand equity, either through "from Maine" positioning; or by developing specific farm/regional brands linked to Maine to communicate high quality and differentiate Maine's products from competitors'
- A continual focus on achieving operational efficiencies, as pricing is projected to moderate over the planning horizon