



Market Analysis of Maine Farm-Raised Sea Scallops

Market Analysis of Maine Farm-Raised Sea Scallops

Submitted to Coastal Enterprises, Inc.

January 10, 2019



www.rbouvierconsulting.com
rachel@rbouvierconsulting.com

Research reported in this publication was supported by the Foundation for Food and Agriculture Research under award number – Grant ID: 554603

The content of this publication is solely the responsibility of the authors and does not necessarily represent the official views of the Foundation for Food and Agriculture Research

*Disclaimer: rbouvier consulting does not represent, warrant, undertake or guarantee that the use of the information in this report will lead to any particular outcome or result. rbouvier consulting further undertakes no liability for any long- or short-term decisions taken by individuals or institutions on the basis of the analysis offered herein.

Cover photos by Hugh Cowperthwaite, CEI.

Contents

Executive Summary.....	4
1. Introduction	5
1.1 Context.....	5
2. PESTEL Analysis	7
2.1 Political.....	7
2.2 Economic.....	8
2.3 Social	9
2.4 Technological	10
2.6 Environmental.....	11
2.5 Legal	12
2.7 PESTEL Summary.....	13
3. SWOT Analysis.....	14
3.1 Strengths.....	14
3.2 Weaknesses	16
3.3 Opportunities.....	17
3.4 Threats	18
3.5 SWOT Summary	19
4. Restaurant Surveys and Industry Interviews	21
4.1 E-Mail Survey	21
4.2 Restaurant Website Survey.....	22
4.3 Industry Perspectives	23
5. Conclusion.....	25
Bibliography	27
Appendix A: Survey Questions.....	31

Executive Summary

This report assesses the potential market environment for Maine farm-raised sea scallops. As the product does not yet exist (there are several experimental sites, but none of commercial scale), we rely on information from test sites, from similar, more established markets, from interviews with several purveyors, growers, and chefs, and from a small survey of Maine restaurants. Table ES-1 lays out the strengths, weaknesses, opportunities and threats facing this new industry.

The overall outlook is promising. Maine has a regulatory and cultural environment that is supportive of fisheries in general and aquaculture in particular. The "Maine brand" is strong, and it is not unreasonable to expect Maine farmed scallops to command a price premium, although how much is not known. Consumers state that they are willing to pay for locally grown, sustainable seafood although proper labelling and education will be essential to realize that benefit.

Moreover, wild fishery sea scallops in Maine are currently harvested during the season from December to April, making fresh scallops available less than half the year. Providing year round, locally raised scallops would not only fill a gap in the scallop supply but do so with a local product that could carry the Maine name. There is the potential for serving scallops in different forms, such as "roe-on" or live on the shell.

Yet there are potential headwinds that the burgeoning industry will have to face. The ear hanging method in particular has high upfront costs, which may discourage some from entering the business. Like any high-end niche market, the industry will be particularly vulnerable to recession. Climate change and biotoxins both pose environmental threats. Entering any potential new industry is both exciting and risky. Undertaking such a risk with a clear understanding of its strengths and weaknesses will help the entrepreneur chart a smooth path.

Table ES- 1: Strengths, Weaknesses, Opportunities, and Threats

Strengths	Weaknesses
<ul style="list-style-type: none"> • Maine name • Food provenance and unique flavor profiles • Existing expertise - Established shellfish industry • Leading edge of industry – access to expertise • Larger scallops • Sustainability • Environmental impact 	<ul style="list-style-type: none"> • High capital costs • Unfamiliar product • Short shelf life • Uneducated consumer • Unfamiliar grow out methods • Low volume of production • Gear availability (nets and machinery) • Biofouling
Opportunities	Threats
<ul style="list-style-type: none"> • Year-round availability of fresh scallops • Buy local trends • Portland restaurant scene • Fishermen can diversify income stream • Sustainability marketing • Tariffs on imports • New food trends • May help mitigate some aspect of climate change 	<ul style="list-style-type: none"> • Climate change impacts • Larger growers • Biotoxins and testing costs • Cheaper imports • Local resistance to aquaculture • Economic instability (recession) • Biofouling • Scallops survival rates

1. Introduction

In 2018, CEI (Coastal Enterprises, Inc.) received a grant from the Foundation for Food and Agriculture Research (FFAR) to conduct research into the economic viability of farmed Atlantic sea scallops in Maine. The aquaculture initiative will rely on a technique where scallops are individually hung on vertical lines, attached by a plastic pin inserted through a small hole drilled through their shell hinge, giving the technique the name "ear hanging." While the technique has been used successfully in Japan, this is the first time it has been used in the United States (Coastal Enterprises, Inc, 2018).

This report assesses the potential market for Maine farm-raised sea scallops. As the product does not yet exist (there are several experimental sites, but none of commercial scale), we rely on information from test sites, from similar, more established markets, from interviews with several purveyors, growers, and chefs, and from a small survey of Maine restaurants.

The report is organized as follows. Section 1 is an overview of the wild inshore and federal scallop fisheries. Section 2 presents a PESTEL analysis, which outlines six areas (political, economic, social, technological, legal, and environmental) that could affect the Maine farm-raised sea scallop industry. Section 3 presents a SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis. Section 4 presents the results of a small survey of restaurants in Maine, interviews with chefs and growers, and a survey of restaurant menus in Maine.

1.1 Context

Atlantic sea scallops are harvested from the waters of two fisheries: inshore state water fisheries (primarily Maine), which consist of the waters within 3 miles of land, and the federal fishery, consisting of waters from 3 miles out to the boundary of US jurisdiction (generally 200 miles). Roughly 98% of US sea scallops are harvested in Federal waters. The vast majority of state-water scallops are harvested in the state of Maine. The Maine inshore fishery is managed by the State of Maine Department of Marine Resources and is comprised of the bays and inlets along the coast of Maine (Maine Department of Marine Resources, 2018). The federal fishery is managed by the New England Fisheries Management Council (NEFMC) and the NOAA Fisheries Service (NMFS) and includes waters from Gulf of Maine south to waters off North Carolina. Once scallops are harvested, they may be frozen at sea, preserved using chemicals, or returned via day boat.

Brief Description of US Atlantic Sea Scallop Industry

The Atlantic sea scallop fishery is considered one of the most valuable commercial fisheries in the United States (National Oceanic and Atmospheric Administration, 2017). Although Atlantic sea scallops were once considered overfished, management efforts (individual fishing quotas, limited access permits, and variable-length closures) have resulted in the species being at or above biomass targets since 2004. In 2018, regulators at the National Oceanic and Atmospheric Administration reopened scallop beds that had been closed for a decade, leading to an increase in landings and a decrease in price. This in turn has

led to an increase in US exports, primarily to France, Canada, and Belgium. The low price, coupled with a high yield of U-10 (“deluxe” size) scallops has led to an increase in domestic demand, with even some casual dining restaurants reintroducing scallops to their menu (Huffman, 2018). Between the healthy supply of domestic scallops and the high level of demand, both domestic and international, analysts predict the market outlook to be robust for some time to come.

Brief Description of the Maine Scallop Industry

While Maine accounts for less than 2% of scallop volume of the Atlantic sea scallop fishery (the remainder hail from federal waters with an insignificant amount from state water fisheries in MA and NH), Maine sea scallops command the highest average price per meat pound, according to a market analysis done for the Gulf of Maine Research Institute (Hale Group, Ltd, 2016). Broadly, the Maine sea scallop industry consists of about 600 licensed scallop fishermen in Maine, of which about 450 are active.

Most of those scallops are harvested using draggers, while a small percentage are harvested by hand by scuba divers, giving them the name “diver” scallops. Day boat scallops are fished from mid-December through April in Maine. Although fishermen are not required to return within 24 hours, because they are limited to 15 gallons (135 pounds) per trip and must stay within state waters, all Maine scallop boats are effectively dayboats.

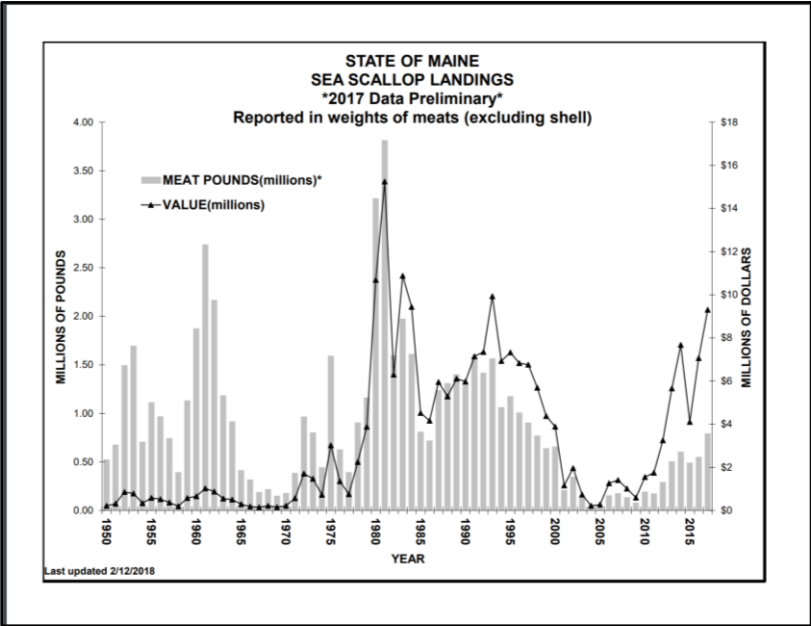


Figure 1: State of Maine Sea Scallops Landings

Figure 1 shows the meat and the value of the sea scallop landings in Maine over the past 68 years. The harvest declined precipitously in the 2000s, leading the state to close some fishing grounds in an effort to save the fishery. Maine’s conservation efforts have been deemed a success, as scallop populations have started to rise again.

The Maine scallop harvest over the past five years is shown in Table 1. The price per pound has fluctuated, with a high of \$12.81 per pound in 2016, and a low of \$8.33 in 2015.

Table 1: Landings and Price of Maine Sea Scallops, 2013-2017

Year	Meat pounds	Whole pounds	Price per Pound
2013	505,838	4,213,627	\$11.18
2014	505,360	5,042,648	\$12.67
2015	492,705	4,104,232	\$8.33
2016	551,323	4,592,523	\$12.81
2017	793,544	6,610,224	\$11.72

Source: Maine Department of Marine Resources. (n.d). Maine Sea Scallop Fishery Information.

2. PESTEL Analysis

A PESTEL analysis is an in depth look at six areas of the current market that could potentially impact a new product or service. It seeks to assess the status of the market into which the product will be introduced. It does not seek to mitigate any of the issues raised but is intended to give an overview of the market as it is. The SWOT analysis that follows is informed by the PESTEL analysis and may present ways the new product may have certain advantages or disadvantages within the market.

The areas that the PESTEL covers are: political, economic, social, technological, environmental, and legal/regulatory. This section looks at these six issues within the state of Maine and, where applicable, nationally and internationally.

2.1 Political

- Strong “buy local” culture
- Strong political support of local industries
- Strong support for Maine agriculture, including aquaculture
- New import tariffs could impact seafood imports

State of Maine

Maine has a very strong buy local culture and its political tendencies reflect that. The state funds several marketing programs to promote Maine products. MaineMade.com, run by the Maine Department of Economic Development, has been certifying and promoting Maine made products and retailers of those products. The Maine International Trade Center, as well, helps support Maine businesses that export internationally (Maine Department of Economic and Community Development, 2018).

In the past decade the Maine State Legislature has passed several pieces of legislation to support local businesses and agriculture. Some are industry specific, such as L.D. 486 to support and promote Maine lobster, or more general, such as L.D. 1584, to set the goal to have private and public institutions, such as schools, jails, universities, community centers in the state of Maine to purchase 20 percent of food

and food products from local farms and fisheries by 2025. The law went into effect in July of 2018 (Strout, 2018).

Maine has several organizations that provide support for particular Maine products and industries. Some such as Wood Heat Maine (<http://www.woodheatmaine.org/>), a program of the Maine Forest Service, was created to support the growing wood pellet industry and receives direct state support from the Maine Statewide Wood Energy Assistance Team. Others, such as the Maine Lobster Marketing Collaborative (<https://lobsterfrommaine.com>), operate independently, but may have members of state government serving on their board.

The state has also shown support for the aquaculture industry. The Maine Aquaculture Association (<https://maineaquaculture.com/>), formed by oyster farmers in 1976, provides resources and support for finfish and shellfish aquaculture. In 1988 the Maine legislature created the Maine Aquaculture Innovation Center to assist in developing aquaculture in the state (Maine Aquaculture Innovation Center, 2018).

International

The national political climate, as well, could affect the Atlantic sea scallop industry. The nation is currently involved in a trade war with China, from whom the United States imports large numbers of frozen scallops. If tariffs are placed on Chinese scallops, it could increase the prices of those imports. The United States imported 49 million pounds of scallops in 2016. By comparison, the total US landings of sea scallops was just over 40 million pounds in that same year (NOAA, 2017). A trade war could create an opportunity for locally caught or farmed scallops which would have a more predictable and stable price (Bryan, 2018).

2.2 Economic

- Aquaculture industry has a strong economic impact in the state
- Consumers willing to pay more for local food
- Fresh scallop sales are currently seasonal
- Value of the dollar

Local Impact

According to a 2017 report by the University of Maine Aquaculture Research Institute the Maine aquaculture industry has an annual economic impact of \$137 million dollars. It has rapidly grown, increasing nearly threefold since 2007 when the economic impact was estimated at \$50 million. (Aquaculture Research Institute, 2017)

Pricing

Numerous studies across the United States have demonstrated that consumers are willing to pay more for products that are locally sourced and sustainably harvested (Grebitus, 2013) (Federal Reserve Bank of St. Louis, 2017). One study by the University of Maine in partnership with Maine Sea Grant surveyed 1,000 Maine consumers. Seventy-five percent of respondents stated they would be willing to pay more

for local and sustainable seafood. How this might translate into behavior at the cash register remains to be seen (Brunton, 2016).

The University of Maine study noted that there is often confusion among consumers as to how to find out where their seafood comes from. With scallops in particular, there are limited sites for the landing and processing of frozen seafood. According to NOAA the primary sites on the east coast are, in order of landing size: New Bedford, MA; Cape May, NJ; and Norfolk, VA. This makes it difficult to track the provenance of particular scallops. Restaurants, which may have direct relationships with harvesters, may not be taking advantage of this market potential by labeling the seafood as a Maine product. The same study noted that out of state consumers, not local consumers, were those who generally inquired about the source of the seafood served in the restaurant (Brunton, 2016). A study published in the journal *Aquaculture Economics and Management* indicated that consumers are willing to pay more for seafood that is seen as local, from within in the borders of their state, but that proper labeling was imperative to ensuring the information was communicated to consumers. (Brayden, Noblet, Evans, & Rickard, 2018).

Seasonal Sales

The scallop season in Maine runs from December to April. This means that during the summer, at the height of tourist season, any Maine scallops that are served had been previously frozen. There is not yet a market in Maine for fresh scallops in the off season as they are simply not available.

Value of the Dollar

The value of the dollar, measured against its competitors' currencies, can affect scallop supply and demand as well. Currently, the dollar is relatively low against the Japanese yen, but it is strong versus euro markets (Lanman, 2018).

2.3 Social

- Consumers are dining out more and spending more per visit
- Perception of shellfish aquaculture is generally favorable
- “Nimby-ism” in Maine
- Maine brand perception

The Consumer

The primary initial consumer for this market will be restaurant patrons. Consumer restaurant spending has been steadily increasing over the past several years with more Americans dining out than ever. Americans eat out an average of 5.9 times per week and are more likely to dine out when they travel (U.S. Department of Commerce, 2018) (Zagat, 2018).

Maine had over 36 million visitors in 2017. While here these visitors to Maine spent over \$6 billion, \$1.5 billion of which was spent on restaurants and food (MOT, 2018). Many visitors to Maine come with the expectation of being able to eat fresh, local, Maine seafood. Maine ranks as the second most “locavore” state in the United States and is fifth in the country with the number of farmers markets per capita. Maine consumers tend to support local agriculture and other products more so than other states in the US (Strolling of the Heifers, 2018).

Perception of Aquaculture

Shellfish aquaculture is generally viewed favorably in the United States. It is seen as the more sustainable option when purchasing seafood. Many consumers currently buy farmed oysters and mussels regularly. In Maine restaurants will list sources such as Bangs Island Mussels on their menus and note that it is a local and sustainable source of mussels.

However there have been two recent instances of opposition to shellfish aquaculture in Maine. In both cases residents have cited noise, environmental impact, and obstruction of scenic views as reasons for their opposition (Barndollar, 2018). It remains to be seen how these cases will play out.

Buy Local Trend

Maine is home to one of the most successful buy local organizations in the country, Portland Buy Local. Consumers in Maine have a high awareness of local food sources and Maine is consistently in the top ten of the Localvore Index, an annual rating of states based on residents' access to local foods (Strolling of the Heifers, 2018). This is a strong environment into which to introduce a new local food product.

Maine Brand Perception

The Maine name is associated with handcrafted quality. The Maine "brand" is also strongly associated with seafood, particularly lobster which are shipped live and frozen all over the world. In a study performed by Foodable in 2016 which took a look at discussions of seafood on social media, chefs most often mentioned seafood from the New England region. Maine lobster had the highest sentimental rating by consumers (Foodable Network LLC, 2016).

Maine is also gaining notoriety as a "foodie" destination. Numerous top-ten lists have listed Portland as a food destination and most recently *Bon Appetit* named the city the "Restaurant City of the Year." (Knowlton, 2018)

2.4 Technological

There are four general methods of farming scallops: bottom ranching, floating cages, bottom cages, and suspended/hanging methods. The method used can vary by scallop species and the location of the aquaculture site (Leavitt, 2010).

Bottom Ranching

Often used for restoration of depleted scallop beds this method involves the release of spat directly into the area where scallops would grow naturally. This method leaves scallops vulnerable to the same issues that any wild scallop faces. Starfish and crabs are an issue as is the scallop's natural mobility. Scallops are harvested through dredging or, depending upon location, by divers.

Bottom Cages

Plastic or metal segmented cages are filled with young scallops and then lowered to the sea floor for the scallops to mature. Scallops grow-out time varies by species and desired size. The cages will be hauled up from the sea floor for harvesting.

Floating Cages

A cage structure is attached to a wooden or plastic floating frame. Scallops are placed in the cages after an initial grow-out period. This method is generally used in more temperate climates where surface water temperature tends to be lower. It is more commonly used for bay scallops.

Suspended/Hanging Methods

Hanging methods utilize a long-line technique. The line is anchored at each end and floats are used to keep the line several feet below the water surface. Nets or dropper lines are then attached at regular intervals to the longline and suspended vertically in the water column. Some varieties of scallops, such as bay scallops, may be grown to market size in nets only. Efforts are underway in Maine to grow Atlantic sea scallops with lantern nets.

Ear hanging

The ear hanging method is commonly used in Japan for growing larger sea scallops. The ear hanging method utilizes pearl and lantern nets for the initial stages of the grow-out which allows for the scallop to come to a size large enough to be ear hung for the final stage of grow-out.

After the interim grow-out phase, a hole is drilled through the scallop hinge (ear) and the scallops are attached to a dropper line that is suspended from the long line. Scallops grown by this method are expected to reach maturity faster than some other methods. They are also less likely to be attacked by predators as they are not on the sea floor. Sea scallops will reach maturity after two to three years (Grant, 2003).

The test sites in Maine are making use of Japanese methods and technology that are currently not in use elsewhere in the United States.

A varied approach

With the exception of bottom ranching, all of the above methods allow for year-round harvest of fresh scallops, an option not currently available for wild harvested scallops. These methods may be used to grow spat, and scallops of varying sizes.

2.6 Environmental

- Industry seen as environmentally sustainable
- Climate change

Sustainability

Shellfish aquaculture is generally seen as environmentally sustainable. It provides relief to existing wild shellfish resource while utilizing a species native to those same waters. In contrast to fin fish aquaculture, it does not add nutrients or other contaminants to the ocean, has negligible accumulation of excrement, and the shellfish provide natural filtration of local waters. Unlike dredging or bottom dragging catch methods it does not have bycatch nor does it generally cause damage to the seafloor. Seafood Watch, run by the Monterey Bay Aquarium, is one of the most widely cited seafood

sustainability rating organizations. It recommends farmed raised scallops as the preferred choice for consumers when buying scallops, with diver caught scallops as the second choice. (Monterey Bay Aquarium, 2018).

Climate Change

Ocean acidification, sea level rise, and warming waters are already impacting the shellfish industry, and are only expected to intensify in the next few decades. These are issues that will not only impact wild harvest operations but aquaculture operations as well. Some shellfish operations in the United States and Canada have faced die offs that may be attributed to ocean warming and acidification (Deese & Arnold, 2014).

2.5 Legal

Regulations

The Maine marine aquaculture industry is overseen by the Maine Department of Marine Resources. Leases are granted to those who wish to establish an aquaculture site in public waters. Aquaculture licenses are required for any aquaculture leaseholder who plans to “remove, possess, transport within the state limits or sell cultured organisms’ grown on the holder’s lease or LPA sites.” License holders may sell their product to wholesalers, at retail at the home of the aquaculture lease holder, or at retail on the aquaculture lease site. (Maine Department of Marine Resources, 2018) Currently aquaculture license holders are prohibited from delivering to restaurants directly unless the grower obtains a shellfish dealers licenses that allow them to sell direct, or, in the case of oysters, whether the restaurant holds an enhanced retail license. (Maine Department of Marine Resources, 2018)

Labeling of seafood

At the federal level, The Lacey Act essentially states that it is unlawful to misrepresent any fish, wildlife, or plant which has been, or is intended to be (1) imported, exported, transported, sold, purchased, or received from any foreign country; or (2) transported in interstate or foreign commerce” (US Fish and Wildlife Service, n.d.). However this generally is only used to enforce violations against importers, wholesaler/distributors, and fishermen. It does not address labeling by restaurants or processors. (Friedman, 2017)

Maine has a statute that prohibits live shellfish from being labelled as “a product of Maine shellfish” if they are not harvested from the waters of the state. (State of Maine, 2011) The law was passed specifically to combat issues with shellfish harvested elsewhere being processed in Maine and labelled as a product of the state in order to market to tourists. However, it does not yet appear to have been enforced, and Maine does not currently have inspection procedures in place nor the personnel in place to enforce it (Friedman, 2017).

2.7 PESTEL Summary

Maine as a state tends to be supportive of local product and industries. It is home to one of the strongest buy local organizations in the country, consistently ranks high on supporting local agriculture, and Maine consumers have shown strong support for locally produced foods and products. The state has several active organizations that support local industries.

The Maine name is widely associated with seafood and seafood products both in the state and across the country, particularly when it comes to lobster. Most recently Portland was listed as the Restaurant City of the Year by Bon Appetit magazine.

Maine consumers are known for putting their money where their mouth is in not only stating that they support local products, but consistently showing up to support local farmers' markets, and a strong farm to table movement. This trend has taken hold across New England with five New England states being included in the top ten of the 2018 Localvore Index. Maine restaurant spending has increased in line with national trends, particularly spending by visiting tourists.

Maine residents have shown some opposition to shellfish aquaculture in two instances in Brunswick and Kittery with worries of increased noise and disruptions of scenic views. How this opposition will be played out remains to be seen. Overall shellfish aquaculture tends to be viewed indifferently or favorably and is given as the more environmentally sustainable option by organizations such as Seafood Watch.

With strong state support for local agriculture industries, a name associated closely with good seafood, and a growing market support for local food, Maine provides a favorable environment for a new, locally produced, fresh seafood product such as farm raised scallops.

3. SWOT Analysis

A SWOT analysis is a review of the strengths, weaknesses, opportunities, and threats of a particular business – in this case a scallop aquaculture operation. It differs from a PESTEL analysis, which is a review of the environment that the new business will be operating in, in that the SWOT analysis evaluates the potential positive and negative effects of that environment. The issues are bulleted in the table below, with more in-depth discussion following.

Strengths	Weaknesses
<ul style="list-style-type: none"> • Maine name • Food provenance and unique flavor profiles • Existing expertise - Established shellfish industry • Leading edge of industry – access to expertise • Larger scallops • Sustainability • Environmental impact 	<ul style="list-style-type: none"> • Capital costs • Unfamiliar product • Short shelf life • Uneducated consumer • Unfamiliar grow out methods • Low volume of production • Gear availability (nets and machinery) • Biofouling
Opportunities	Threats
<ul style="list-style-type: none"> • Year-round availability of fresh scallops • Buy local trends • Portland restaurant scene • Fishermen can diversify income stream • Sustainability marketing • Tariffs on imports • New food trends • May help mitigate some aspect of climate change 	<ul style="list-style-type: none"> • Climate change impacts • Larger growers • Biotoxins and testing costs • Cheaper imports • Local resistance to aquaculture • Economic instability (recession) • Biofouling • Scallop survival rates

3.1 Strengths

- *Maine name*
- *Food provenance and unique flavor profile*
- *Existing expertise - Established shellfish industry*
- *Leading edge of industry – access to expertise*
- *Larger scallops*
- *Sustainability*
- *Environmental impact*

Scallop aquaculture in Maine, and specifically the ear hung method being reviewed by CEI, has several inherent strengths. A primary one is the Maine name itself. Maine is known for its seafood and tourists come to Maine intending to partake of fresh, local seafood and restaurants make sure that many of

these products are labeled as such on their menus. Unlike scallops processed and frozen en masse at processing facilities outside the state, Maine farm raised scallops will have a known provenance – a strength in a state with a strong buy local economy and one which can also bank on the established Maine name. Scallops, similar to oysters, also develop a flavor profile unique to the waters they are raised in. This could be of benefit should the flavor be one that proves desirable to chefs and consumers.

Maine has an established shellfish industry. While the ear hanging method is new to the state, the shellfish industry is not. Legislation governing fish and shellfish aquaculture goes back over a century (Maine Department of Marine Resources, 2018). Scallop growers would be introducing a new product into an existing industry and could take advantage of their established contacts and connections within that industry.

There is a strong relationship between Maine growers and growers in Japan that has developed over a 20-year exchange. Growers in the state may be introducing new techniques to this part of the world, but they are not entering entirely uncharted waters.

Growers who become involved with the ear hanging technology now would be on the leading edge. They would also do so with access to the expertise of growers already using this method in other parts of the world. Should the market for fresh, locally grown, sea scallops take off these early adopters could be primed to dominate the market.

Shellfish aquaculture is generally viewed favorably by consumers and environmental organizations. It does not introduce new nutrients into the marine environment and instead, through the natural scallops natural feed process, tends to leave the water cleaner than before. Suspended scallop aquaculture does not damage the seafloor, as dredging can do, and does not have the same issues of by-catch (other species caught in the dragging net that were not the primary targets of the fishermen). Studies have also shown that small mollusks have a much lower environmental impact than other protein sources such as beef, chicken, and fin fish aquaculture (according to a life cycle assessment that was done for the journal *Frontiers in Ecology and the Environment*) (Hilborn, Banobi, Hall, Pucylowski, & Walsworth, 2018).

There may also be some evidence that shellfish aquaculture may help mitigate some aspects of climate change, specifically the increasing CO₂ levels in the ocean. One study on oysters concluded that they may be as effective at carbon sequestration as other accepted biosequestration methods, such as planting trees. It was noted to be particularly effective on a regional basis. The scale needed to make a significant impact is not fully known, but this may be used as another highlight in promoting the industry. (Hickey, 2005)

3.2 Weaknesses

- *High capital costs*
- *Unfamiliar methods*
- *Gear availability (nets and machinery)*
- *Unfamiliar products*
- *Low volume of production*
- *Short shelf life*
- *Uneducated consumer*

The ear hung method of scallop aquaculture has high upfront costs of \$100,000 or more for equipment. Capital funding for a start-up aquaculture operation may be difficult to come by (Aquaculture Research Institute, 2017). The high up-front cost could limit the number of growers who can enter the industry successfully and thus also limit the availability of the product. While exclusivity can create higher prices, it can also cause buyers to overlook a new product due to a lack of availability or significant volume. Finding avenues for growers to obtain the capital they need to embark on this new method will be essential. In addition, studies from Canada show that the ear-hung method needs to be tuned to the specific aquaculture site and usually needs a number of years of “patient research and trial-and-error” (Dadswell, 2001).

Once capital is obtained growers will need a reliable source for nets and machinery, particularly for those intending to make use of the ear hanging method. The shortage of U.S. based suppliers may increase capital costs. Should the market become established and other growers enter the market, the equipment may become more readily available and bring costs down.

The number of growers is currently limited. While this may make the product more desirable due to its rarity, it is likely to cause some hesitancy on behalf of buyers who may not want to commit to purchasing without having a reliable supply. One of the greatest weakness growers face is one that confronts all new products: unfamiliarity. Consumers who buy scallops for eating at home or at restaurants will need to be educated on the benefits of the product. Our research indicates that while many local restaurants do list the provenance of some seafood, most do not currently list the source of their scallops or the method by which they are raised. (See section 4, below.) Of those that do, the method of catch is often what is noted – such as day boat or diver scallops. Many consumers do not know that the scallops they purchase in a summer visit to Maine have been frozen prior to being prepared for their consumption. There will need to be some education of the consumer needed to help grow the market for this product.

While being a fresh product is a strength, it also means that it has a much shorter shelf life. Scallops will need to be moved from harvest, to sale, to consumption in a matter of days. Building a strong market to receive these scallops will be essential to establishing and maintaining the industry (Lobster Anywhere, 2018).

Finally, the survival rate and quality of the product is dependent on the management practices of the growers. Nets and lines that are neglected face issues such as being lost due to storms, fouled lines, and

overgrowth of unwanted biofouling. These issues can result in losses for the grower, higher scallop mortality rates, and difficulty in harvesting.

3.3 Opportunities

- *Year-round availability of fresh scallops*
- *Buy local trends*
- *Portland restaurant scene*
- *New food trends*
- *Fishermen can diversify income stream*
- *Sustainability marketing*
- *Value of the dollar*
- *Tariffs on imports*

Restaurants in Maine see a large boost in their customer base during the summer. Those that cater to tourists often note where their seafood comes from and that it is fresh. However, the scallop season in Maine runs December to April, meaning that fresh local scallops are not available during the height of tourist season during the summer months. All Maine scallops sold in restaurants during this time were previously frozen (or inaccurately labeled). Serving freshly harvested scallops could be an opportunity for restaurants to differentiate themselves to the consumer – and the only source for these fresh scallops would be those grown in an aquaculture operation.

The consumer market for sustainable, locally grown food is strong. As noted earlier, the buy local market in Maine is particularly robust. Studies have shown that consumers are willing to pay more for food that meets the sustainably grown and locally sourced criteria (Brunton, 2016). Maine itself ranks high on the annual Localvore Index, coming in second in 2018.

Maine has seen regular increases in tourism in recent years, with a 2.5% increase in 2017 over 2016 visits. In addition, visitors' restaurant spending increased by 2%, which is in line with national trends on restaurant spending (MOT, 2018). Portland is already known for its restaurant scene, and with the naming of it as the Restaurant City of the Year, it can be expected to continue to grow. This is good news for a product that is likely to have restaurants as its initial primary market.

More casual dining restaurants are offering scallops on their menus due to the lower price of scallops in recent years. While the lower price might seem an obstacle to overcome, it is also an opportunity, as consumers who may not have been exposed to scallops before may develop a taste for them. Those new consumers may then be more likely to choose scallops on a menu when travelling or in a more upscale dining establishment (Huffman, 2018).

Fresh scallops may also offer the opportunity for new ways of serving scallops. Scallops in the US are generally not served whole: it is only the adductor muscle that is eaten. Principally, this is due to the fact that deadly biotoxins can accumulate in the other parts of the scallop. It is possible that under carefully controlled growing conditions, Maine-farmed sea scallops may be able to be served whole. Maine chefs may be able to develop new and innovative ways to serve whole scallops once the option to do so is available to them.

Scallop aquaculture may also provide an opportunity for fishermen to diversify their income. In an industry where fish catches have declined, fishing areas have been closed, and the climate change poses a threat to the lobster industry, scallop aquaculture may provide a more dependable source of income for fishermen who are able to start their own farms (St. George Dragon, 2018). It is also an opportunity for a burgeoning industry, as growers can take advantage of fishermen's experience.

Another opportunity has to do with the value of the dollar. In 2017, the US dollar was relatively low versus the Japanese yen, prompting Peter Handy of Bristol Seafoods to predict that imports of Japanese scallops to the United States will fall. In addition, the weak dollar makes US exports relatively more attractive, leading US exporters to increase their market share. The combination means that domestic scallops may be in short supply, despite the re-opening of domestic scallop beds (Huffman, 2018). However, since that time, the dollar has risen against the yen, although it is still well below its five-year high, set in 2015.

Finally, import tariffs imposed by the Trump administration are impacting the price of seafood imports which may cause prices to rise dramatically on some products (Bryan, 2018). While rising prices of imports may not directly impact Maine farmed scallops as they are currently a niche product, the price instability may help turn attention to local sources of seafood.

3.4 Threats

- *Climate change impacts*
- *Cheaper seafood imports*
- *Biotoxins and testing expenses*
- *Biofouling*
- *Local resistance to aquaculture*
- *Economic instability (recession)*
- *New growers*

Climate change and ocean acidification is a very real threat to the shellfish industry, one that will impact wild caught as well as farm raised shellfish. Increased levels of carbon dioxide in the ocean alters the pH of the water, preventing some larvae from making shells, slowing down the rate of shell growth (resulting in smaller shellfish), or making the animal more vulnerable to predators. Mussels, for example, may face as much as a 25% decrease in overall size. It is not yet known in any significant detail how ocean acidification is likely to affect scallop aquaculture in particular, however (Ocean Portal, 2018). Some shellfish growers in the US and Canada have reported die offs that they attributed to ocean warming and acidification (Deese & Arnold, 2014).

Likewise, biotoxins are always a threat to shellfish, and the same will be true for farm raised scallops. Growers may find that they face this threat more frequently as their scallops can be harvested year-round – including the summer when the organisms that produce them are more active. Growers will need to keep up to date on closures and respond accordingly. Those intending to sell a live whole

scallop will also face expensive testing to show their product is clear of the toxins (Maine Department of Marine Resources, 2018). Consumers may respond negatively should it be known there is a local outbreak even if the scallops they are ordering have been shown to be safe.

Scallop operations that are close to shore also face the risk of biofouling due to sewage spills and stormwater runoff. This may be mitigated by choosing locations that are safe distances from water treatment facilities and stormwater overflows. However, those located near river outlets may face this issue from waters upstream.

Fresh farm raised scallops may, at least at first, be a premium product in the market, making them more vulnerable to economic ups and downs. Should the country enter a recession, consumers are likely to eat out less and spend less when they do. Food consumed outside the house is an area of spending that is slower to recover when the economy turns around (Reed & Crawford, 2015). While predicting a recession is risky, many economists are beginning to do just that, despite unemployment being at historic lows (Arnold, 2018).

As with any premium product, fresh scallops may face a decline should the economy take a downturn. During times of recession dining out is one of the first areas that consumers begin to tighten the financial belts, with grocery expenses following soon behind. It would be of benefit to growers to seek to expand the market beyond restaurants and high-end grocery stores as soon as they are able in order to create a more diverse customer base and aid in recession proofing the industry.

The aquaculture industry has been generally well received in Maine. However, there have been some recent instances of opposition to shellfish aquaculture in Maine. In most cases residents have sited noise, environmental impact, and obstruction of scenic views as reasons for their opposition (Barndollar, 2018) The “NIMBY” (or Not In My BackYard) attitude towards aquaculture can pose a threat to growers in the state.

While being on the leading edge of an industry has its benefits, it also has its risks. Being the first means you also face the issues and obstacles first, which can cost time and money with bringing a product to market. As the market grows and becomes lucrative others may seek to join the industry, creating competition and spreading an already small, niche market. In addition, as the industry grows, demand for equipment and supplies may grow, making them more expensive and raising costs.

3.5 SWOT Summary

The greatest obstacle that farm raised scallops face is that they are essentially a new product. While the shellfish itself is not new, this form of it is. There will need to be a strong effort to educate first chefs and then patrons of their establishments. Consumers may be less likely to prepare whole scallops at home and opt for the more easy-to-prepare adductor muscle only. Retail sales may depend greatly upon the education of consumers and product availability.

However, there are many strengths that can assist with this. People want to perceive their food as being fresh and restaurants would like to offer the freshest food possible to their customers. Add in the

strong buy local and farm to table movement in Maine and there is the possibility of great opportunities available for this product in the restaurant market.

Growers who are setting up operations now will have the benefit of being on the leading edge of the industry. Their product will be able to enter the market first and likely command higher prices. As with any new product, if it is successful, there will be others who enter the market at a later date creating more sources for product but also benefiting from the path cleared by those who entered the market early. This could impact future prices.

Some of the issues that growers will face include the impacts of climate change on Maine waters. Ocean acidification and warming water temperatures can impact scallop growth rates. While growers may be able to move operations to better locations, it could be an expensive proposition.

It should also be noted that as a premium priced product that is intended, at least at first, to be primarily marketed through restaurants, the product is particularly vulnerable to recession. Dining out and vacation spending are some of the first activities that consumers cut back on when they are faced with tighter budgets. Grocery spending also often decreases during these times with consumers spending making fewer luxury food purchases.

The success of this product will be greatly depend on convincing the intended buyer, restaurants and possibly high-end food retailers, of the benefits of the product and how it is different from the types of scallops currently available (adductor-only, fresh or frozen, dry or processed). This effort is likely to greatly rely on consumer preference for locally sourced, sustainable products, and restaurants that want their name to be identified with these attributes.

4. Restaurant Surveys and Industry Interviews

4.1 E-Mail Survey

To get a better idea of the seafood purchasing practices of restaurants in Maine, an email survey was created and sent to 106 restaurants in the Portland, Augusta, and Bangor areas. Survey questions are available in Appendix A. E-mail addresses were purchased from Reference USA, after determining the establishments within the restaurant industry. Ten of the email addresses bounced back, leaving 96 addresses. We received eight valid responses were received, a response rate of 8.3 percent.

Nonetheless, we can still glean some insights from those responses. Four of the eight respondents stated that they were the proprietor of the organization, two were chefs, one was a manager, and the remaining respondent wrote in “owner/chef.” Seven respondents indicated that their primary business was a restaurant, while one respondent indicated “hotel.”

In response to the question, “Do your customers ever ask questions regarding the *sustainability* of the seafood you offer?”, two respondents indicated “yes, frequently”; two responded “yes, sometimes”; and three responded “not very often.” However, one respondent indicated that their restaurant only serves food from sustainable sources, meaning that their customers don’t need to ask.

The question “Do your customers ever ask questions regarding the *origin* of the seafood you offer?” generated similar responses. Three respondents indicated “yes, frequently.” Two responded, “yes, sometimes.” One responded, “not very often.” The remaining two wrote in that they either only served local food, or that they informed their customers of the origin of the seafood that they served.

We asked whether respondents differentiated seafood on their menu according to origin, sustainability, or catch method. Excluding the one restaurant that claims to only serve local, sustainable foods, two answered “yes,” four answered “no,” and one answered “sometimes.”

Six of the eight respondents indicated that they served farmed shellfish at their restaurant. When asked how they sourced it, five indicated that they used a wholesaler, while one said they bought direct from the grower.

As stated earlier, one of the strengths of growing scallops in Maine is the possibility of having fresh Maine sea scallops all year round, instead of only during the season. When asked the question, “if fresh farmed Maine sea scallops were available year-round, would your restaurant be interested in serving them?” three indicated “yes, definitely;” three indicated “probably;” and two indicated that it would depend on variables like price, quality, consistency, texture, and taste.

However, when asked whether their customers would likely pay a premium for such a product, results were split. Only one said, “yes, definitely.” Two said, “probably,” while two said “probably not.”

Figure 2 shows responses to the question, “Have you ever purchased the following? Check all that apply.

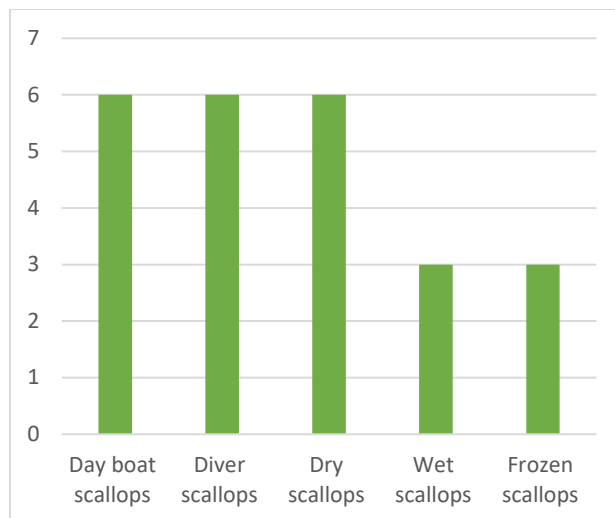


Figure 2: Types of Scallops Purchased

The fact that less than half of the respondents indicated ever having bought wet or frozen scallops says something about the sample who choose to respond to the survey.

The majority of respondents indicated an interest in roe-on scallops. Two indicated that they had served roe-on scallops previously, while three indicated that they had not, but would if it were available. Two indicated that they would not serve roe-on scallops even if they were available, while one was unsure.

Due to the small number of respondents and the likelihood that respondents were self-selected, the results cannot be generalized to other restaurants in Maine. However, results are indicative of an interest in fresh Maine-farmed sea scallops, the possibility of being able to charge a premium, and a general interest in serving roe-on scallops, at least within our sample.

4.2 Restaurant Website Survey

We reviewed the websites of 41 Portland restaurants that received high ratings by consumers in the fine dining category on Yelp (Yelp, 2018). We chose this site as it was a good indicator of consumer dining preferences in Portland. For each website we reviewed the following attributes:

- Promotion of locally sourced foods
- Promotion of sustainability
- Identification of source of seafood on menu
- Identification of source of scallops on menu

Results

Our results showed that over half the restaurants actively promoted locally sourced foods somewhere on their website. As can be seen in Figure 3, that number dropped dramatically when we looked for references to sustainability such a noting that food was responsibly sourced, or had low ecological impact.

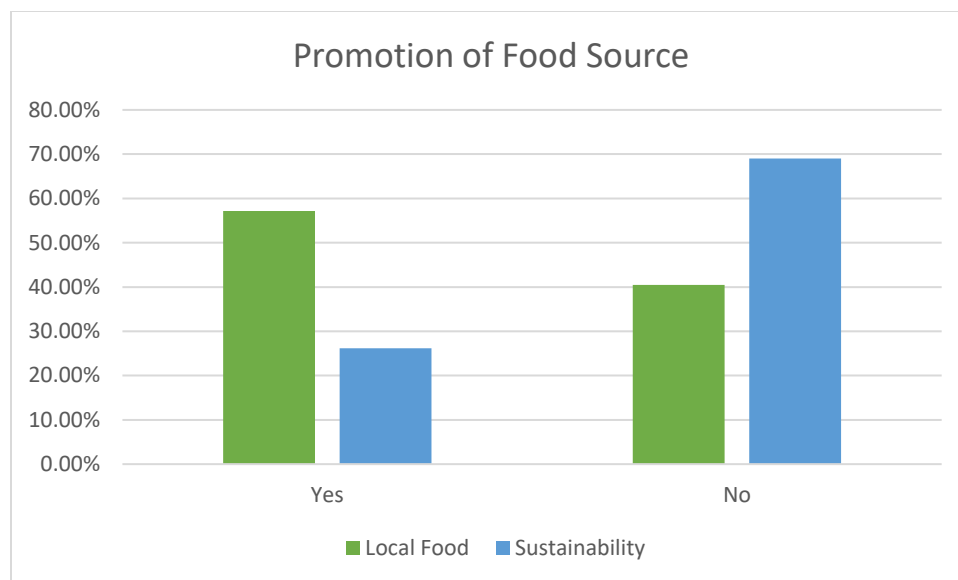


Figure 3 Promotion of local foods and sustainability

Restaurants reviewed had an average of 5.49 non-scallop seafood items on their menu. Despite the high number of restaurants promoting local food, only 35% of these restaurants noted the source of their seafood on their menus. Of these, 35% noted Maine as the source of at least one of their seafood items. This included lobster, clams, and mussels. Three restaurants specifically mention Bangs Island Mussels as their mussel source. Most restaurants, 85.7%, did not note if the seafood was fresh or frozen. This may have been in part due to the fact that online menus are often only sample menus and those with fresh items might be more likely to note it on the menu used in the restaurant on a particular day.

Scallops were on the menu of 33% of the restaurants of those reviewed. Only one of these noted the geographical origin of the scallop. Five restaurants did note the catch method of their scallops with four referring to dayboat scallops and one noting diver scallops.

4.3 Industry Perspectives

We interviewed several key individuals, each representing a different stage in the process from scallop growth to chef: a grower, an aquaculture technical assistance specialist, a shellfish dealer/distributor, a specialty caterer, and a chef. Their perspectives are presented below.

Aquaculture Business Owner

We interviewed the owner of an aquaculture business located in Maine who was involved in the production of growing scallops on a test basis. They indicated that they were seeing some good growth and were pleased so far. They had had a few customers (they sell exclusively to wholesalers) express interest in the finished product who were excited by the novelty of the product. But the flavor profile remains to be seen. While wild scallops move around, cultured scallops will be constrained to one location, so the flavor profile of farmed versus wild caught scallops is still an unknown. It is anticipated that a specific flavor profile of farmed raised scallops would add to the value (“think wine varieties

specific to growing locations”). There is no *a priori* reason to assume that the flavor of farmed scallops would be less desirable than wild. Likewise, the specific shape of ear hung scallops (they are expected to be “taller” than wild scallops) might add to their value as well.

When asked about whether Maine farm grown sea scallops might be able to command a premium, much like other Maine products, the respondent was cautiously optimistic, replying that yes, probably, but it remains a hypothetical. Much of it hinges on the relationship between the distributor and the grower. Our respondent elaborated, saying that “if the distributor is interested in passing the growing (vs. harvesting) information down the chain of custody to subsequent buyers and users, it will command a premium price. If the distributor is only looking to sell more scallops, than I doubt there would be a premium and I would not take them on as a customer.”

Aquaculture Technical Assistance Expert

The aquaculture technical assistance expert we interviewed is cautiously optimistic about the possibility of Maine farmed sea scallops commanding a premium, pointing out that, historically, the meats that are landed in the State fishery command a higher price than those in the Federal fishery. But he is unsure how those prices will hold up with increased volume. As mentioned above, scallop fishing grounds in Federal waters have recently been reopened, as well as some state scallop grounds, leading some to wonder if the influx of scallops will cause the price to crash. But so far there hasn't been any indication of that. Moreover, the amount of scallops that the U.S. imports from overseas relative to the size of the federal fishery indicates that the market is far from being saturated.

As far as distributing the product to market, our respondent offered the opinion that working with a reputable wholesaler is the way to go. The key in this market, he believes, is to talk up the attributes of the product and to tell its story. He has also been working with his colleagues on other products besides just the adductor muscle --for example, whole or roe-on scallops. Those are relatively rare commodities, which explains the enthusiasm shown by some chefs. No other state is allowing harvesters to sell anything but the adductor muscle, which means that roe on and whole scallops are generally not available. Again, the high cost of biotoxin testing is a huge hurdle in bringing those products to market. The question, he says, is whether that cost will be a hurdle or a showstopper.

Shellfish Dealer / Distributor

We also interviewed someone involved in the growing and distribution of seafood. While their primary business is growing oysters, they have been assisting the Maine Aquaculture Co-op in growing scallops via longlines for about two years. To date, they have sold about 50,000 petite sea scallops. They served them raw, on the shell (the area in which they grow their scallops has been tested and approved). As far as the reception, our respondent says that the scallops were very well received – but that they were strategic about where they chose to introduce the product. They chose chefs who were understanding of the process, wanted a new and exciting product, and had very few prior expectations. There was no risk of failure, he said, because they had had conversations with the chefs and knew their customers.

When asked about the scalability of the market for Maine farm-raised scallops, our respondent was hesitant. One of the things that made the product attractive, he felt, was its novelty. Once the product scales up, it would lose that caché. However, much like other respondents, he did feel that the “halo effect” of the Maine brand would extend to this product. He also expressed optimism that farmed

scallops would be able to offer a superior consistency, size, and shape to wild-caught products, but cautioned that the expense could prevent it from being a mainstay. This echoed other reservations we ran across in our research and our interviews: by ramping up the production, growers could decrease the cost per scallop. At the same time, by making the product more widely available, the product could lose some of its novelty, and therefore its marketing edge.

Special Event Caterer

We spoke with someone in the special events and catering business in the New York City area. He specializes in seafood, and serves a considerable amount of scallops, mostly raw. He is very selective about where he sources his scallops – he only buys from purveyors that he trusts. When asked whether his customers ask questions regarding the sustainability or the origin of the seafood he serves, he responded that he does get some questions, but not many. He showed some skepticism about whether customers “actually care” about the sustainability of the food that they buy – he says that “everybody wants to be sustainable, but they also want the cheapest price.” His belief is that most customers only ask about sustainability so that they can tell themselves that they’ve made the effort. Similarly, he feels that consumers are indifferent between farmed and fresh shellfish, with most being unaware or uninterested in the method of growth or even harvest.

Despite that, he does feel that marketing the scallops as coming from Maine would allow the product to command a premium. Like many of our other respondents, he feels that just the word “Maine” is worth something to consumers – although how much, he is not certain. He does feel that the proper way to sell the scallops is through purveyors, not direct to chefs. “Chefs are lazy,” he said, explaining that in his experience, chefs try to get all their seafood from one place, rather than sourcing their product direct from the growers. There are exceptions, of course – but getting it into the right hands is going to be key. He was also quite enthusiastic about serving roe on scallops, as such a product is not widely available. The only drawback, he said, echoing others, is the cost of testing for biotoxins.

Chef

Finally, we interviewed a local chef who serves sustainable, locally grown food exclusively. As can be expected, he was enthusiastic about the possibility of serving fresh, Maine-farmed scallops. His customers are already well aware of the importance of consuming local food grown and harvested in a sustainable manner. As far as purchasing habits go, his restaurant does buy day boat scallops in season, and he buys directly from the fishermen with whom he has a good relationship. When asked whether he might pay a premium for Maine-farmed scallops, his response was ambiguous: “It depends on the premium.” However, he then amended his statement, saying that even if they farmed scallops were substantially more expensive than day boat scallops, his restaurant might purchase them during the tourist season, when fresh Maine wild scallops are not available.

5. Conclusion

This report has outlined the context within which Maine scallop aquaculture will develop. The overall outlook is promising. Maine has a regulatory and cultural environment that is supportive of fisheries in general and aquaculture in particular. The “Maine brand” is strong, and it is not unreasonable to expect

Maine farmed scallops to command a price premium, although how much is not known. Consumers state that they are willing to pay for locally grown, sustainable seafood although proper labelling and education will be essential to realize that benefit.

Yet there are potential headwinds that the burgeoning industry will have to face. The ear hanging method in particular has high upfront costs, which may discourage some from entering the business. Like any high-end niche market, the industry will be particularly vulnerable to recession. Climate change and biotoxins both pose environmental threats. Entering any potential new industry is both exciting and risky. Undertaking such a risk with a clear understanding of its strengths and weaknesses will help the entrepreneur to chart a smooth path.

Bibliography

- Aquaculture Research Institute. (2017). *Maine Aquaculture Economic Impact Report*. Orono: University of Maine.
- Arnold, C. (2018, June 28). "Is the US Headed For Recession?". *National Public Radio: All Things Considered*.
- Barndollar, H. (2018, October 19). *State denies Kittery's request to delay aquaculture ruling*. Retrieved from Seacoast Online: <http://www.seacoastonline.com/news/20181019/state-denies-kitterys-request-to-delay-aquaculture-ruling>
- Brayden, W. C., Noblet, C. L., Evans, K. S., & Rickard, L. (2018). Consumer preferences for seafood attributes of wild harvested and farm raised products. *Aquaculture Economics and Management*.
- Brunton, C. (2016, June 6). *UMaine research shows Maine consumers willing to pay more for food sustainably harvested, seafood from the state*. Retrieved from University of Maine: <https://umaine.edu/news/blog/2016/06/06/umaine-research-shows-maine-consumers-willing-pay-food-sustainably-harvested-seafood-state/>
- Bryan, B. (2018, July 11). *Trump wants to hit another \$200 billion worth of Chinese imports with tariffs — here's what could get slammed*. Retrieved from Business Insider: <https://www.businessinsider.com/trump-china-tariff-list-goods-2018-7>
- Coastal Enterprises, Inc. (2018, April 23). *CEI Leads Project to Introduce Commercially-Viable Scallop Farming in Maine*. Retrieved from CEI News and Events: <https://www.ceimaine.org/news-and-events/news/2018/04/cei-leads-project-to-introduce-commercially-viable-scallop-farming-in-maine/>
- Conte, F., Passantino, A., Longo, S., & Voslorova, E. (2014). Consumers' Attitude Towards Fish Meat. *Italian Journal of Food Safety*, 3(3).
- Dadswell, M. (2001). A Review of the Status of Sea Scallop Aquaculture in Atlantic Canada in the Year 2000. *Aquaculture Association of Canada Special Publication No 4*, 72-75.
- Deese, D. H., & Arnold, S. (2014, May 21). *Gulf of Maine uniquely susceptible to ocean acidification*. Retrieved from Working Waterfront Archives.
- Federal Reserve Bank of St. Louis. (2017). *Harvestig Opportunity: The Power or Regional Food System Investments to Transform Communities*. St. Louis, MO: Federal Reserve Bank of St. Louis.
- Foodable Network LLC. (2016). *Seafood Trends 2016 report*. Foodable.
- Friedman, S. (2017). *Not Just Floundering Around: A Post-Regulatory Framework to Address Seafood Substitution*. Portland, ME: May.
- Fryrear, A. (2015, July 17). *What's a Good Response Rate?* Retrieved from Survey Gizmo: <https://www.surveygizmo.com/resources/blog/survey-response-rates/>

- Gardiner Pinfold Consulting Economists Limited. (2001). *Development Potential of the Maine Scallop Industry*. Augusta, ME: Department of Marine Resources.
- Grant, J. &. (2003). Growth advantages of ear hanging compared to cage culture for sea scallops, *Placopecten magellanicus*. . *Aquaculture*, 301-323.
- Grebitus, C. L. (2013). Effect of distance of transportation on willingness to pay for food. *Ecological Economics*, 88.
- Hale Group, Ltd. (2016). *Maine Farmed Shellfish Market Analysis*. Portland, Maine: Gulf of Maine Research Institute.
- Hickey, J. (2005). *Carbon Sequestration Potential of Shellfish*. Retrieved from The Fish Site: <https://thefishsite.com/articles/carbon-sequestration-potential-of-shellfish>
- Hilborn, R., Banobi, J., Hall, S., Pucylowski, T., & Walsworth, T. (2018). The environmental cost of animal source foods. *Frontiers in Ecology and the Environment*, 16(6), np.
- Huffman, J. (2018, March 19). 2018 scallop surprise: Despite larger harvest, currency rates could flatten US supply. *Undercurrent News*.
- Huffman, J. (2018, January 4). NOAA to open New England scallop areas, invite record harvest. *Undercurrent News*.
- Huffman, J. (2018, Jan 25). Scallops poised to jump back on US casual restaurant menus. *Undercurrent News*.
- Knowlton, A. (2018, August 7). *Portland, Maine, Is the 2018 Restaurant City of the Year*. Retrieved from Bon Appetite: <https://www.bonappetit.com/story/portland-maine-city-of-the-year-2018>
- Lanman, S. (2018, July 20). *Quicktake: The Strong Dollar*. Retrieved from Bloomberg: <https://www.bloomberg.com/quicktake/almighty-dollar>
- Leavitt, D. S. (2010). *Grow-out Culture of the Bay Scallop*. College Park, MD: Northeastern Regional Aquaculture Center.
- Lobster Anywhere. (2018). *Scallop 101: How to Buy Fresh Scallops on Dry Land or Online*. Retrieved from Lobster Anywhere: <https://lobsteranywhere.com/seafood-savvy/how-to-buy-fresh-scallops/>
- Maine Aquaculture Innovation Center. (2018). *Who We Are*. Retrieved from Maine Aquaculture Innovation Center: <https://www.maineaquaculture.org/>
- Maine Biz. (2018, September 25). *Size of proposed oyster farm draws opposition*. Retrieved from Maine Biz: <http://www.mainebiz.biz/article/20180925/NEWS01/180929973/size-of-proposed-oyster-farm-draws-opposition>
- Maine Department of Economic and Community Development. (2018, August 9). Retrieved from Marketing Assistance Programs: <https://www.maine.gov/decdec/start-grow/business-assistance/>
- Maine Department of Marine Resources. (2018, August). Retrieved from AQ License Summary: <https://www.maine.gov/dmr/aquaculture/documents/AQLicensesummary.2.pdf>

- Maine Department of Marine Resources. (2018, May 14). *Biotoxins in Maine*. Retrieved from Maine Department of Marine Resources: <https://www.maine.gov/dmr/shellfish-sanitation-management/programs/biotoxininfo.html>
- Maine Department of Marine Resources. (2018). *Maine Shellfish Dealer Certification and Inspection Program*. Retrieved from Maine Department of Marine Resources: <https://www.maine.gov/dmr/shellfish-sanitation-management/programs/certification.html>
- Maine Department of Marine Resources. (2018). *Scallop Boundaries Web Map*. Retrieved from Maine Department of Marine Resources: <https://maine.maps.arcgis.com/apps/webappviewer/index.html?id=b228645f8a0e46a4b6594b4b995ee133>
- Maine Department of Marine Resources. (2018). *What is Aquaculture*. Retrieved from Maine.gov: <https://www.maine.gov/dmr/aquaculture/whatis.html>
- Monterey Bay Aquarium. (2018). *Seafood Watch*. Retrieved from Scallop Overview: <https://www.seafoodwatch.org/seafood-recommendations/groups/scallop/overview>
- Morse, D. (2015). Long-term Outcomes in the Tech Transfer of Scallop Spat Collection Techniques, from Aomori Prefecture, Japan to Maine, USA. *Bulletin of Japan Fisheries Research and Education Agency*, 40, 167-172.
- MOT. (2018, January). *How Tourism Spending Effects Maine*. Retrieved from Maine Office of Tourism: <https://motpartners.com/research/economic-impact/>
- National Oceanic and Atmospheric Administration. (2017). *2016 Annual Report of the Atlantic Sea Scallop Individual Fishing Quota Cost Recovery Program*. Gloucester, MA: National Marine Fisheries Service.
- NOAA. (2017). *Imports and Exports of Fishery Products Annual Summary 2016*. Washington, DC: National Oceanic and Atmospheric Administration, U.S Department of Commerce.
- Ocean Portal. (2018, April). *Ocean Acidification*. (J. B. (NOAA), Editor) Retrieved from Ocean - Find your blue.
- Reed, S., & Crawford, M. (2015, June). *How does consumer spending change during boom, recession, and recovery?* Retrieved from Bureau of Labor Statistics: <https://www.bls.gov/opub/btn/volume-3/how-does-consumer-spending-change-during-boom-recession-and-recovery.htm>
- Schick, D., & Feindel, S. (2005). *Maine Scallop Fishery: Monitoring and Enhancement*. Augusta, ME: Maine Department of Marine Resources. Retrieved from <https://www.maine.gov/dmr/science-research/species/scallops/research/documents/necrpt.pdf>
- St. George Dragon. (2018, April 11). *St. George Dragon*. Retrieved from New scallop aquaculture coop aims to diversify a fishery while keeping profits 'at the shore': <http://stgeorgedragon.com/new-scallop-aquaculture-coop-aims-to-diversify-a-fishery-while-keeping-profits-at-the-shore/>

- State of Maine. (2011). *Revised Maine Statutes, Title 12: Conservation, Part 9: Marine Resources Subpart 1, Chapter 601*. Retrieved from Maine Legislature Revised Maine Statutes: <http://legislature.maine.gov/statutes/12/title12sec6005.html>
- Strolling of the Heifers. (2018, May 25). *2018 Localvore Index*. Retrieved from Strolling of the Heifers: <https://www.strollingoftheheifers.com/locavore/>
- Strout, N. (2018). *Bill to require state institutions to buy local foods becomes law*. Portland, Maine: Portland Press Herald. Retrieved from <https://www.pressherald.com/2018/07/11/bill-to-require-state-institutions-to-buy-local-foods-becomes-law/>
- U.S. Department of Commerce. (2018, September 14). *Economic Indicators*. Retrieved from Commerce.gov: <https://www.commerce.gov/economicindicators>
- US Fish and Wildlife Service. (n.d.). *The Lacey Act*. Retrieved from US Fish and Wildlife Service: <https://www.fws.gov/le/pdffiles/Lacey.pdf>
- Yelp. (2018, August). *Best Fine Dining in Portland Maine*. Retrieved from Yelp: https://www.yelp.com/search?find_desc=Fine+Dining&find_loc=Portland%2C+ME
- Zagat. (2018, January 7). *2018 Dining Trends Survey: Highest Tippers, Social Media Habits and More*. Retrieved from Zagat: <https://www.zagat.com/b/2018-dining-trends-survey-highest-tippers-social-media-habits-and-more>

Appendix A: Survey Questions

1. What is your primary position / title?
 - a. Proprietor
 - b. Chef
 - c. Manager
 - d. Other - Write In (Required)
2. What is your primary business category?
 - a. Restaurant
 - b. Other - Write In
3. Do your customers ask questions regarding the sustainability of the seafood you offer?
 - a. Yes, frequently
 - b. Yes, sometimes
 - c. Not very often
 - d. Other - Write In
4. Do your customers ask questions regarding the origin of the seafood you offer?
 - a. Yes, frequently
 - b. Yes, sometimes
 - c. Not very often
 - d. Other - Write In
5. Do you differentiate seafood on your menu or in your offerings based on origin, sustainability, or catch method?
 - a. Yes
 - b. No
 - c. Other - Write In (Required)
6. Do you buy any farm raised shellfish?
 - a. Yes
 - b. No
7. If you answered "yes" to the previous question, please select the source of the farmed shellfish that you buy. You may select more than one option.
8. If fresh Maine farmed sea scallops were available year-round, would your restaurant be interested in serving them?

- a. Yes, definitely
 - b. Probably
 - c. Other - Write In (Required)
9. Would you be able to charge your customers a premium for fresh, Maine-farmed sea scallops?
- a. Yes, definitely
 - b. Yes, probably
 - c. No, probably not
 - d. Other - Write In (Required)
10. If fresh scallops are not available, do you use frozen?
- a. Yes
 - b. No
11. Have you ever purchased the following? Please check all that apply:
- a. Day boat scallops
 - b. Diver scallops
 - c. Wet scallops
 - d. Dry scallops
 - e. Frozen scallops
 - f. Other - Write In (Required)
12. Have you ever served "roe on" sea scallops?
- a. Yes
 - b. No, and I would not even if it were available
 - c. No, but I would if it were available
 - d. Other - Write In (Required)
13. Is there anything else you would like us to know? If so, please give your comments or suggestions here.