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**Cultivating Cooperatives: Benefits and Challenges of Co-ops and
Recommendations for Maine's Emerging Aquaculture Industries**

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Submitted in Partial Fulfilment of the
Professional Science Master's Degree
in Ocean Food Systems
School of Marine & Environmental Programs
College of Arts and Sciences

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Abstract

Two emerging Maine industries, kelp (*Saccharina latissimi* and *Saccharina angustissima*) and Atlantic sea scallop (*Placopecten magellanicus*) aquaculture, have enormous market, environmental, and social potential but are faced with challenges of small scale and limited operations, inadequate infrastructure, market visibility, and limited expertise. Because many industries, particularly the dairy industry, have benefited from the use of cooperatives (co-ops) to aggregate an extremely perishable product, quickly process and effectively market and distribute, this research explores the cooperative model as a potential tool for the nascent scallop and kelp industries. Aquaculture co-ops are new in Maine. The first, the Maine Aquaculture Co-op (MAC), formed in 2016 to help develop the sea scallop aquaculture industry. As more farmers come online to sell and demand grows, the co-op needs to determine its next direction. Furthermore, the lack of kelp processors in Maine is hampering that industries' growth. To make recommendations to MAC, a theoretical kelp co-op, and aquaculture co-ops in general, this research determined the benefits and challenges of co-ops, and the important factors that influence co-op structures. Ten aquaculture, agriculture and fishery co-ops were researched through data mining, participant observation, and semi-structured interviews. The factors to consider for defining the structure of a co-op are whether: 1) the co-op will act as a distributor, 2) product will be marketed using individual member branding or co-op branding, 3) if members are required to sell through the co-op or will sell individually, and 4) members' geographic proximity to one another. The ten benefits of the co-op model are 1) shared labor and personnel, 2) group purchasing, 3) shared infrastructure, 4) community relations, 5) banking, 6) industry entry and growth, 7) market stability, 8) grants, 9) knowledge sharing, and 10) democratic membership. The challenges to co-ops are 1) member cooperation, 2) financial returns, 3) and disputes over branding. Short-term recommendations for MAC are based off findings from two small, established aquaculture co-ops that have a co-op distribution facility and mostly independently producing farmers who occasionally cooperatively farm and share farm equipment. Product is branded by member farms, but all transactions pass through the co-op. Recommendations for a kelp co-op are based off large scale marketing co-ops where raw materials are aggregated from farms, processed into value added products, and marketed and distributed.

1. Project Objectives & Significance

Scallop and kelp aquaculture in Maine have enormous potential to be prosperous industries, contributing to Maine's economic, environmental, and social resilience (Coastal Enterprises Inc., 2019; Piconi et al., 2020). However, numerous challenges are facing these industries dominated by small-scale producers. Some of the obstacles are unique to the industry, and some are common to small businesses. Aquaculture co-ops, including the Maine Aquaculture Co-op (MAC), are forming in Maine in response to these challenges. Through working with MAC and various aquaculture, agriculture and fishing co-ops, this project researches the benefits and challenges of the co-op business model and factors to consider when establishing a co-op, so that producers and industry developers may be informed on its potential usefulness to support and grow Maine's emerging aquaculture industries.

2.0 Background

To understand the usefulness of co-ops for emerging aquaculture industries in Maine, relevant background knowledge was gathered. First is thorough overview of co-ops, their history, and principles, and Maine’s history with co-ops. Next, to understand of the landscape of the seafood industry in Maine, a history of Maine fishing and aquaculture was investigated. Following this, an overview of farmed Atlantic sea scallops and kelp was done to help articulate why a co-op would be useful for these industries. This background section also introduces the Maine Aquaculture Co-op (the researcher’s industry connection), a case study for how the cooperative model works with scallop aquaculture.

2.1 The Co-op model

A cooperative is an association and a business jointly owned and democratically controlled by those that benefit from its services (Frederick et al., 2016; Fairbairn, 2004). Its purpose is to provide shared economic, social and cultural needs that members would not be able to obtain individually (International Cooperative Alliance, n.d). In this, it differs from other business models because its goals are not strictly financial (Cotterill, 1983).

2.1.1 Types of Co-ops

There are many types of cooperatives. Not all co-ops fit into neat categories, and certain industries may operate across various types of co-ops. However, the following is a reasonable breakdown.

	Retail or consumer	Worker	Service	Producer
Ownership	Owned by those who shop there	Owned and run by workers	Owned by community members	Owned by farmers, fishermen, craftsmen, or any producer
Benefits	Members receive store discounts and special opportunities	Employees own the store and have control of the profits	Fills a need in a community or provides an industry a service	Members receive benefits of collective production, processing, and marketing.
Examples	Hardware, grocery, clothing stores	Bakeries, breweries, retail stores	Childcare, funeral services, clinics, bargaining co-ops	Dairy, fishing, agriculture co-ops
Specific Examples	REI, Portland Food Co-op	Local Sprouts, Fedco Seeds	Franklin Buying Club	Cabot Creamery, Blue Diamond

Table 1 Definition and examples of four categories of co-ops

Retail or consumer cooperatives are owned by those that shop or visit there and can be hardware, grocery, clothing stores and more. Not all customers are members, but members receive special opportunities and discounts. This type of co-op particularly benefits small towns where industries have closed, creating a need, or a lack of competition and unfair prices (Cotterill, 1983; Types of Cooperatives, n.d.).

Worker cooperatives seem similar to consumer co-ops but are slightly different. They are owned and run by co-op members, whereas a consumer co-op has members that may be minimally involved in the day to day operation. Worker co-ops can include bakeries, breweries, retail stores, and aquaculture. Worker co-op businesses may be small, but studies show they are often bigger, more productive, and more profitable for

employees than conventional businesses (Types of Cooperatives, n.d.; Pérotin, 2016). Critics of worker co-ops warn that without a single boss, decisions are slowly, or never, made (Samuels, 2016).

Service co-ops provide a need in a community, like child-care, funeral services, or clinics (Types of Cooperatives, n.d). However, purchasing co-ops, which are often used by farmers to bulk purchase raw materials, are also considered service co-ops (Cooperative Assistance Network Limited, n.d). Bargaining co-ops provide the service of collective bargaining to get a better price in the marketplace and are therefore similar to marketing co-ops (USDA Rural Development, 2000). Marketing cooperatives, which collectively sell goods, are sometimes defined as a service co-op, and sometimes considered a producer co-op (Cooperative Assistance Network Limited, n.d; Co-opLaw.org, 2019). Therefore, the actual type of co-op is less important than what happens and the benefits it provides its members.

Producer co-ops provide members some combination of production, processing, marketing and distribution of their products. A producer co-op may support the “upstream” side of the process, like purchasing, or the “downstream” side, like marketing, stages of production, or all stages (Sexton, 1986). Farmer, fishery, and aquaculture co-ops may be considered a producer co-op (Types of Cooperatives, n.d). The following research pertains to producer co-ops, which is considered an umbrella co-op that includes purchasing, marketing, and services (Frederick et al., 2016).

A type of producer co-op, marketing co-ops, pool product from members, providing them scale they could not achieve otherwise. Marketing co-ops help producers with services, like processing, not previously available, they create enough volume to meet demand, they spread out risk and increase price negotiating power. Furthermore, it streamlines the process from producer to consumer, giving the members more control over their product and the price. Dairy cooperatives are often marketing co-ops because member farms independently produce milk, which is sold to the co-op for all other services (United States Department of Agriculture Rural Development, 2000).

2.1.2 Co-op principles

Although there are many types of co-ops, certain common principles pertain to all. Cooperative principles relate back to self-help, self-responsibility, democracy, equity, equality, and solidarity, which are cooperative core values according to the International Co-operative Alliance. For one, benefits received, whether financial or otherwise, are in proportion to how much the member uses the co-op (Frederick et al., 2016). A straightforward input-output example is that the more a fisherman sells through the co-op, the greater dividends he or she will receive at the end of the year (T. Sylvester, personal communication, March 4, 2020). Or, the more a member shows up to meetings, the more influence he or she will have in decision making (personal observation). Another principle is that membership is open to anyone, regardless of gender, race, religion, and politics, although members may need to be voted in. To contribute to their independence, members often pay dues, initially or annually, or financially participate equitably in some way. Some co-op principles are found in many other businesses; they often provide education, training, and information, and there is concern for the community they operate in (International Cooperative Alliance, n.d).

The USDA produced a report that outlines what it considers the three principles for producer co-ops. There is the User Benefit Principle, the User Owner Principle, and the User-Control Principle. The first states that co-ops must be advantageous for its members, providing services, power, and size not otherwise attainable. The User Owner Principle is that the members own the co-op, including the assets. This also means that they must contribute financially in order to keep the business running. The third, the User Control Principle, states that through democratic and equal voting, members control the co-op and agree on leaders (Frederick et al., 2016). These principles developed over hundreds of years of co-op history.

2.1.3 History of the co-op

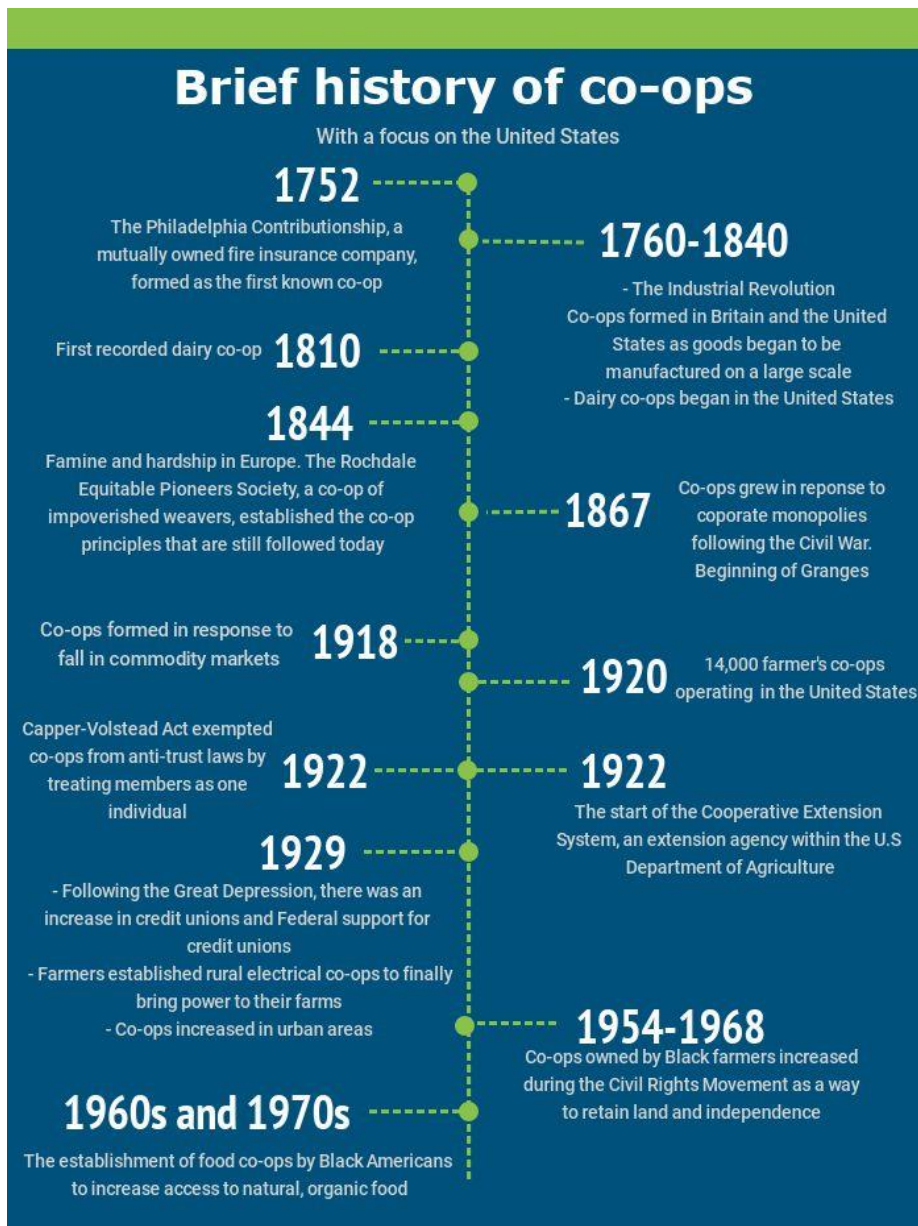


Figure 1 A timeline of surges in cooperatives and supporting laws in the United States, with some events in the U.K.

Cooperatives develop and grow in popularity during times of societal and economic transformation because they allow members independence and autonomy over their own livelihoods (Fairbairn, 2004). Although cooperation is not new to human culture, the first cooperative business is thought to be a mutually owned fire insurance company established in 1752 in Philadelphia (Frederick et al., 2016; Roger & Crane, 2008). Not long after, many co-ops formed during the Industrial Revolution in England and the United States (Watson, 2017). The Industrial Revolution transformed society: people urbanized, new means for wealth evolved, and goods were manufactured on a large scale (Ashton, 1997). What was once produced by many individuals or households shifted towards a few large companies. This was challenging for both small producers and those trying to purchase the goods at reasonable prices (Watson, 2017). In Britain, individuals from certain regions or classes struggling economically with this change formed co-ops to resist the transition towards big business (Frederick et al., 2016; Watson, 2017). In the United States, the developing dairy industry pushed the creation of farmer's co-ops. Cooperative handling of milk, processing into cheese, and transporting to market

allowed farmers to operate despite the perishability of milk and minimal infrastructure (Frederick et al., 2016). Today, 86% of dairy in the United States comes from co-ops (Huang et al., 2013).

The popularity of co-ops continued in 1844 with the Rochdale Equitable Pioneers Society, a consumer co-op in England formed by impoverished weavers (Mayo, 2017). The society assisted and encouraged others to form co-ops, and they recorded a set of principles and characteristics that helped form the basis of all co-ops today (Mayo, 2017). For example, the principles inspired the Grange cooperative movement in the United States. Granges, associations of farmers, set up stores that sold groceries, goods, clothing and more to serve rural members. The setup of these co-ops was based on the Rochdale principles and formed the backbone of agricultural cooperatives today. By 1920, 14,000 farmers co-ops in the United States were in operation (Frederick et al., 2016).

Just as co-ops grew out of economic hardship and change during the Industrial Revolution, many more and many types of co-ops emerged during the 20th century. Following WWI, Marketing co-ops grew in popularity in reaction to the drop in commodity prices. Marketing collectively, or “pooling”, through large, centralized co-ops helped control the market and prices (Fairbairn, 2004). Although farmers were the force behind this growth in co-ops, legislation became more supportive during this time (Fairbairn, 2004). The Clayton act in 1914 established antitrust laws, while the Capper-Volstead act of 1922 exempted non-profit marketing co-ops from said laws (15 U.S.C. § 12; 7 U.S.C. § 291). The Capper-Volstead act means that members of a co-op are treated as one individual so they can legally reduce competition and agree on prices (Frederick et al., 2004). Cooperatives may also legally work together as one big marketing co-op (7 U.S.C. § 291). There are certain qualifications to be considered under this act, which are based on cooperative principles. For example, each member must only receive one vote, regardless of the amount of stock or capital invested. Once met, the co-op is held to the same antitrust standards as any other business (Volkin, 1985).

In the same year as the Clayton Act, the Smith-Lever Act created the Cooperative Extension System, who’s research and services resulted in many co-ops. Federal support continued with the Cooperative Marketing Act of 1926, which put the Secretary of Agriculture in charge of cooperative marketing and pledged support of cooperative marketing by the USDA (7 U.S.C. § 452; Fairbairn, 2004).

During the privation of the Great Depression, cooperative credit unions and related federal support helped farmers with banking and loans (Pitman, 2018). Today, credit unions are one of the most common types of co-ops (Fairbairn, 2004). Co-ops also helped black farmers during the civil rights movement retain land and independence (Pitman, 2018). In the 60’s and 70’s, when access to natural and organic food was challenging, consumer food co-ops grew in popularity (Pitman, 2018). The idea soon spread to multiple demographics, but they were originally meant to benefit African American communities. The co-ops started as “buying clubs”, intent on finding whole foods such as brown rice and lentils. Eventually they established actual storefronts, worked with farmers, and offered discounts to members. (Kauffman, 2017). Today, food co-ops are reviving in rural towns and the food deserts of cities to supply the same needs as decades before (Kauffman, 2017).

Economic and societal change spurred cooperative growth historically. Today, with climate change, covid-19, and a new emphasis on local food and community, cooperatives may again help individuals take control of their future. Maine’s long history of co-ops is witnessing new growth as aquaculture industries emerge.

2.1.4 History of Maine co-ops

Cooperatives first grew in popularity in Maine during the 20th century to help dairy farmers market their products (Maine Memory, n.d). Although the largest dairy company in Maine, Oakhurst Dairy, began as a family business in 1921, in 2014 it was acquired by Dairy Farmers of America, a massive co-op serving 13,000 farms (Richardson, 2014). Furthermore, many Maine farmers belong to co-ops with headquarters in other states.

For example, Agri-Mark, which merged with Cabot Creamery in 1992, buys milk from New York and New England farmers, including Maine (M. Turner, personal communication, February 26, 2020). Potato agriculture, Maine's second most valuable market, also benefits from co-ops (Overton, 2020). Maine Potato Growers, established in 1932, is a farming co-op that markets grains and potatoes and sells farming equipment and supplies (mpgco, n.d).

Lobster co-ops, serving Maine's most valuable market, began in the 40s and 50s (Overton, 2020; Wheeler, 2009). Just as so many other co-ops formed as a way for individuals to take back control from big businesses, lobster co-ops helped discontented lobstermen lower the price on bait and get better prices for their lobster. Frustrated with a few big dealers organizing the prices, co-ops helped create real competition in the market. The first lobster co-op, Pemaquid Harbor Cooperative, began in 1947, is one of the oldest fishermen's co-ops in the country, and is still going strong. By the 60s, there were five lobster co-ops in Maine (Wheeler, 2009). Today, there are about twenty (Dinsmore, 2011; Wheeler, 2009).

It wasn't until 2016 that the first Maine aquaculture co-op was formed: The Maine Aquaculture Co-op. In 2020, the first two oyster co-ops formed: The New Meadows Shellfish Cooperative and the Georgetown Oyster Cooperative (P. Rand, personal communication, February 28 2020; P. Burns, personal communication, March 10 2020).

2.2 Maine seafood industries

2.2.1 Small-scale

There are few things that Maine is more famous for than its ocean. Maine was an early fisheries powerhouse for the United States, and the trend continues today, with Maine ranked second with Massachusetts in value and volume of commercial fishery landings (NOAA, 2017; Woodard, 2004). Historically, Maine's fishing fleet was made up of many small, individually owned boats, even when other states began consolidating into larger, more efficient craft. (O'Leary, 1996). Today, this phenomenon continues: There are over 6,000 lobster boats, and most are under twelve meters and run by one or two person crews (Acheson & Gardner, 2011). Social and economic independence was, and still is, important for Mainers, and fishing allowed this freedom. Through these values and quirks grew a working waterfront defined by small-scale businesses and modest livelihoods.

2.2.2 Maine Aquaculture

The burgeoning aquaculture in Maine is no exception to the state-wide trend of small and owner-operated businesses. (Lazur et al., 2010). Maine has about 200 aquaculture farms, with an average of 3.5 employees per farm (McEvoy, 2019). Despite the small size of the farms, production is increasing. Between 2007 and 2016, the direct economic impact from aquaculture grew from \$50 million to \$137 million (The University of Maine, 2016).

However, even with the growth, some Mainers are resistant to multiple large-scale, land-based finfish aquaculture farms proposed in recent years. For example, Norway-based Nordic Aquafarms and their \$500 million salmon farm is caught up in a permitting battle with the city of Belfast's minority, but very vocal opposition (Curtis, 2019). Those opposed have loud voices and deep pockets that have skewed the public perception of large-scale aquaculture.

Small-scale operations are driving the growth of two nascent aquaculture industries: Atlantic sea scallops and kelp.

2.2.3 Atlantic sea scallops

Biology

The species that is both fished and cultivated in Maine is the Atlantic sea scallop (*Placopecten magellanicus*) (Packer et al., 2004). It is a filter feeding bivalve mollusk with a typical maximum adult shell height of six inches (NOAA, n.d). The shell height is measured from the umbo, where the hinge is, to the outer edge, or ring, of the shell (figure 2) (Harris & Stokesbury, 2006). The top and bottom shells are different colors: the top is reddish pink or brown and the bottom is cream or white. Their shells are smooth (NOAA, n.d).

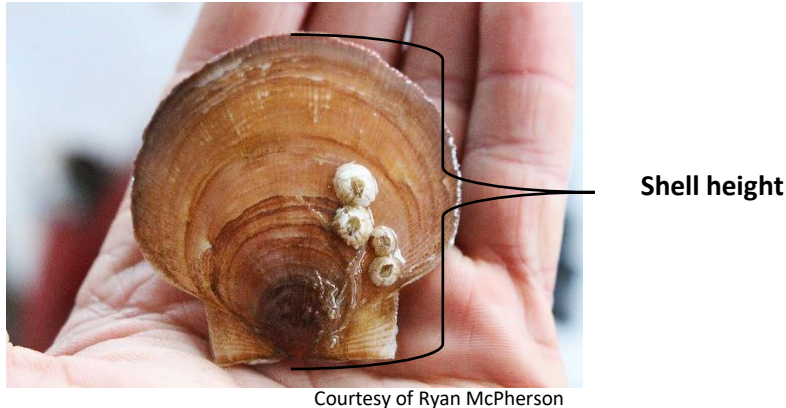


Figure 2 Shell height is measured from the umbo to the outer ring of the shell

The species ranges from Labrador to North Carolina and they are found in depths between 18 and 110 meters (NH Fish and Game, 2015). Interestingly, in Maine and parts of Canada, they are also found in estuaries and embayments in depths as little as two meters (Packer et al., 2004). Adults are found on firm sand, gravel, shells or rock bottoms (NH Fish and Game, 2015). Atlantic sea scallops are tolerant to a variety of water temperatures: depth and food availability are the critical factors (Packer et al., 2004). They typically mature around four years of age, and may live until twenty (NOAA, n.d; Packer et al., 2004). Sea scallops spawn semi-annually, in the spring and the late summer or fall, and each female may produce hundreds of millions of eggs per year, making them the most fertile of the bivalves (NH Fish and Game, 2015; NOAA, n.d; Packer, et al., 2004, Thompson et al., 2014). The eggs sink to the bottom to avoid predation, but at the larval stage are found throughout the whole water column (Packer et al. 2004). After about four to six weeks at the swimming stage, the spat will settle on gravelly sand, shell fragments, navigation buoys and sedentary plants and animals (NOAA, nd.; Packer et al., 2004). They survive better on hard surfaces than mud or sand (Packer et al. 2004). Atlantic sea scallops feed on phytoplankton and other small organisms found in the water column, improving water quality. Pelagic fish and invertebrates like cod, flounder, lobster, sea turtles, and sea stars feed on sea scallop larvae, juveniles and adults (NOAA, n.d).

Regulation and Red Tide

To escape, sea scallops swim by using their large adductor muscle to open and close their shell (Packer et al., 2004). Until sea scallops were farmed, the adductor was the only part that could be harvested and eaten in Maine (NOAA, n.d). Because of Red Tide, US Federal Law states that sea scallops must be “shucked at sea”, bringing to shore only the unaffected adductor muscle and dumping overboard all remaining tissue and shells (Maine Sea Grant, n.d). Red Tide is the explosion of toxic microscopic plankton that accumulates in shellfish as they filter feed. Eating shellfish affected by Red Tide can cause Paralytic Shellfish Poisoning (PSP), sometimes resulting in asphyxiation and death (Townsend et al., 2001). Every year in Maine, shellfish beds and farms are closed due to Red Tide (DMR, 2018). However, the time it takes a scallop to flush out toxins is much longer than other bivalves (Cembella, 1993). Furthermore, even if a scallop bed is monitored like other shellfish, due

to their mobility, the scallops may come from other, impacted beds (D. Morse, personal communication, April 9, 2020). Therefore, until scallop aquaculture, only the adductor could be eaten.

The harvesting season for wild sea scallops in Maine is December to April (Maine Sea Grant, n.d). They're commonly harvested with a scallop drag, but sometimes caught by hand by divers (Coastal Enterprises Inc., 2019). Although once overfished, due to their fecundity and management strategies, including individual fishing quotas and closures, they are now above the target population level (Coastal Enterprises Inc., 2019; NOAA, n.d). Since the 2005-2006 season, wild scallops must have a shell height of four inches to be harvested (Schick & Feindel 2005). In 2018, NOAA reopened ten-year closures, resulting in more supply, a lower price, and strong domestic and international demand and markets (Coastal Enterprises Inc., 2019). Although Maine makes up less than two percent of the US Atlantic sea scallop fishery, Maine scallops receive the highest price per meat pound (Coastal Enterprises Inc., 2019).

Scallop Aquaculture

Interest in farming scallops began in the 90s. Farmed scallops fill a supply gap when wild scallops are out of season, they limit damage to the seafloor caused by dragging, and they could provide relief to wild populations (Coastal Enterprises, Inc., 2019). Additionally, estimates predict that the domestic supply of sea scallops will fall short of demand by about fifty percent, resulting in the import of smaller, frozen scallops (The Hale Group, LTD. & The Gulf of Maine Research Institute, 2016). Furthermore, there is a greater variety of products available from farmed scallops since they may be harvested at any size, and in some cases can be served whole body or roe on (Coastal Enterprises, Inc., 2019).

In 1999, a delegation from Maine visited Aomori, Japan to learn from experts on scallop cultivation. In 1994, Maine and Aomori officially became sister states to recognize Aomori citizens saving four sailors and burying the rest after a Maine built ship sank in 1989 off the coast of Japan. Through this relationship formed a practice of knowledge and cultural exchange, which in 1999 included scallop aquaculture (Coastal Enterprises Inc., 2018). Since then, there have been multiple trips to acquire more knowledge and equipment (Overton, 2016). Two successful methods of cultivation, ear hanging and lantern nets, are now used in Maine (Rappaport, 2014), and Maine is the first place in the United States to attempt ear hanging scallops (Coastal Enterprises Inc., 2019). Both methods use a longline system anchored at each end with floats to keep the lines suspended in the water column. Along the line, lantern nets or dropper lines are suspended vertically (Coastal Enterprises Inc., 2019). Lantern nets use varying mesh sizes depending on the growth stage to house scallops on multiple layers. About 200 scallops can fit on each layer at the nursery stage, and about 13 fit when they're ready to sell (a shell height of a few inches) (Brewer et al., 2020). To grow an even larger product, the ear hanging method is used because above a certain size, the lantern nets would be too heavy, or the density of scallops too low to be feasible (Brewer et al., 2020). After initial grow out in a lantern net, a hole is drilled through the shell hinge, a plastic pin is inserted, and the scallops are hung individually on a vertical line. Although labor or equipment intensive, ear hanging is thought to help scallops grow quicker and protect them from predators (Coastal Enterprises Inc., 2019).

As there are no sea scallop hatcheries in Maine, spat is collected in the wild using spat bags. Spat bags have a fine mesh outer layer that lets only larval scallops enter, and a larger mesh inner layer that they can attach and grow on (Anderson, 2015). The bags are attached to a vertical line that is anchored to the bottom with a buoy at the top in a water depth of greater than 200 feet (Brewer et al., 2020). Spat bags are set for about six weeks in the late summer and fall when scallops are spawning, and the bags catch the spawn before it settles (Brewer et al., 2020; H. Twombly, personal communication, April 10, 2020). To avoid conflict with wild scallop fishermen, spat is sometimes collected over mud where the scallops would not survive otherwise (Brewer et al., 2020). After collection, the bags are moved to safer waters, and sorted in the spring (H. Twombly, personal communication, April 10, 2020). When the juveniles are four to six millimeters, they are

ready to be sorted out from other organisms that settled on the bag. This is either done by hand or machine (Anderson, 2015; Brewer et al., 2020).

The 1999 trip to Japan marked a new era of scallop farming in Maine and the United States; one backed by new knowledge and equipment. The trip was to Mutsu Bay, where Japanese have been growing *Patinopecten yessoensis* on longlines and the seabed for generations. Although still in its infancy in Maine, there are now several growers, continued research, product development, supportive regulatory policies, and new markets (Maine Aquaculture Innovation Center, n.d). Grants to purchase special equipment from Japan have been especially encouraging to growing the industry because they help mechanize labor-intensive steps (Coastal Enterprises Inc., 2018). For example, an ear drilling and pinning machine can process ten to twenty thousand scallops a day per person running the machine (A. De Koning, personal communication, March 7, 2020)

The Market

In 2017, Glidden Point, which now sells under the name Coastal Harvesters, began selling a two and a half inch to three-inch live scallop product. This size scallop came into competition with bay scallops in Boston and New York, so efforts were focused back on the potential market in Portland, where they do extremely well, especially with Asian restaurants. Chefs like being able to shuck the live and clapping scallops themselves, and since they're buying by the piece, they know exactly what they're getting. The larger scallops are more popular, especially with high end wholesalers, and they're sold later in the year to not compete directly with the day boat, wild-harvested scallops. The smaller two-inch scallops are marketed directly to consumers and restaurants as a unique raw bar item (Brewer et al., 2020). Although popular, there remains challenges to growing this industry.

The Challenges

The biggest hurdle to growing the farmed scallop market is inconsistent supply. Other challenges are inconsistent grading, lack of consumer knowledge, and price sensitivity (Brewer et al., 2020). Inconsistent supply hampers the ability for restaurants to put the scallops on the permanent menu, instead of just on an occasional basis when available from farmers as specials (Brewer et al., 2020). In order to reach the scale and consistency necessary for an established rather than emerging market, production needs to increase, either through more farms or larger farms. The cost of getting into scallop farming, especially ear-hanging, can be prohibitive. For example, the initial cost for ear-hanging equipment can be \$100,000 or more (Coastal Enterprises, Inc., 2019). Additionally, the limited U.S. equipment suppliers keep prices high, and bulk orders from Japan can cost tens of thousands of dollars and be logically challenging (Coastal Enterprises, Inc., 2019; C. Cleaver, personal communication, March 7, 2020). Limited supply also hampers scallop visibility on the market. Demand is strong for scallops, but farmed scallops compete with day boat, wild-harvested scallops certain times of the year, which have a greater presence on the market. Furthermore, demand for smaller, "princess" (around 2-3 inches shell height) scallops is low, largely because it is a novel product. The benefit of product diversity through farming scallops is not yet appreciated by the market. These conditions mean that without clever solutions, scallop aquaculture in Maine will remain a niche industry.

2.2.4 Kelp

Biology

The two most commonly cultivated species of kelp in Maine are sugar kelp (*Saccharina latissima*), and skinny kelp (*Saccharina angustissima*) (Maine Sea Grant, n.d). In this research, "kelp" will refer to sugar kelp and skinny kelp, which differ slightly in appearance, but have similar growing conditions. In the wild, kelp grows on rocky, intertidal areas in depths of up to 60 feet. They can grow up to 25 feet long and live between

one and three years (Schmitt, 2013). They attach to rocks using a holdfast, which looks like roots of a tree, they have a hollow stem known as a stipe, which keeps the kelp flexible and helps it float, and their blades are long and leathery (Redmond et al., 2014; Schmitt, 2013). Sugar kelp has broad edged blades that are either ruffled in low energy environments or narrow in higher energy environments. Skinny kelp has, as the name suggests, skinny blades (Grebe et al., 2019). Sugar kelp has a range of Maine to Long Island Sound (Schmitt, 2013), but skinny kelp was recently discovered as a distinct species and is therefore only found in a few locations in Maine (Maine Sea Grant, n.d).

Sugar and skinny kelp have two phases: a macroscopic sporophyte phase and a microscopic gametophyte phase. During the sporophyte stage, sorus tissue forms, making the blade appear dark and thick. The tissue releases genetically distinct zoospores into the water column, which settle on suitable substrate, then enter the gametophyte stage where they become either male or female. Next, they produce gametes or eggs, which fertilize each other, creating a zygote. The zygote turns into a very tiny sporophyte, which will grow into an adult (Redmond et al., 2014). Kelp cultivation currently relies on collecting wild reproductive sorus tissue in the spring and fall, which are released onto seed string in a hatchery (Kim et al., 2017). The tissue produces billions of spores per plant, so impact to wild populations is minimal. To mimic spore release in the wild, tissue is dried out and then submerged in water. Spores are released into water containing a large spool of thread, where they eventually settle. This is called seed string or a seed spool (Redmond et al., 2014).

Farming

At one to two millimeters in length, the seed spool is strung on longlines set between two anchors (Redmond et al., 2014). The line may be up to 600 m (1,968 ft) in length and is held about ten meters (33 ft) below the surface, but these measurements will vary depending on the site (Bak, 2019). The lines are submerged around September, and harvested in the spring (Redmond, et al., 2015). Kelp grows quickly in the winter, as much as two to five meters (6.5-16.5 feet) in six months, because of increased nitrogen availability and decreased competition (Piconi et al., 2020; Grebe et al., 2019). Most farmers are under contract with processors and receive seeded string from a nursery (Piconi et al., 2020). For example, Atlantic Seafarms will give growers seed for free, if they can buy all the kelp from the farmer.

Kelp grows very well in Maine because of its cold, clean waters, rocky, variable coastline, and dramatic tides. Furthermore, the culture of fishing in Maine supports the growth of aquaculture (Redmond et al., 2015; Piconi et al., 2020). In Maine, farms are often tended weekly, making them excellent supplemental income (Piconi et al., 2020). Many kelp farmers have other seafood related jobs like lobstering or shellfish aquaculture, and kelp is harvested during the shoulder season of those other industries (Redmond et al., 2015). Unlike scallop aquaculture, farms are inexpensive to set up and maintain, costing less than \$1,000 for the equipment for a 122m (400 ft) longline in Maine (Grebe et al., 2019). In Maine, there is a long history of wild rockweed harvesting in Maine for food, fertilizer, medicinal, and industrial uses, which has helped usher in an era of kelp cultivation (Piconi et al., 2020). In general, Maine is supportive of the kelp industry. The first kelp farm in the United States was in Casco Bay, Maine, and Maine produces about 60 percent of farmed, edible seaweed in the country. Maine had a fivefold increase in the harvest of farmed seaweeds between 2018 and 2019, and a 21-fold increase between 2015 and 2019 from 15,000 wet pounds to 325,000 wet pounds (Grebe et al., 2019; Piconi et al., 2020).

The Market

Globally, 97 percent of harvested seaweed is farmed. Wild and cultivated seaweed produces 80 billion pounds, with a growth rate of about eight to ten percent annually. Eighty-five percent is for human consumption, and the rest is for animal feed, biofuel, pharmaceuticals, and cosmetics. Although Maine is a leader in the United States for edible seaweeds, about 99.5 percent of global seaweed production occurs in Asia and the Pacific Rim (Piconi et al., 2020). About 27 percent of global production is kelp (Grebe et al., 2019).

Although seaweed cultivation in North America and Europe is so low, it is made into specialty and high valued products, creating more value per pound than in Asia (Grebe et al., 2019). In Maine, the price per wet pound is about \$.40-0.70 or \$6-8 per dry pound. (Piconi et al., 2020). In Japan, for example, sugar kelp is sold for about \$0.26 per wet pound (Watson, n.d). With final stage processing, Maine kelp is valued at anywhere between \$10 to over \$50 per pound (Piconi et al., 2020)

In the United States, kelp is grown in Maine, New Hampshire, Massachusetts, Connecticut, Rhode Island, Washington and Alaska (Redmond et al., 2015). Domestically, between 385,554 kg (850,000 lb) and 419,573 kg (925,000 lb) (wet) of edible seaweed was harvested in 2019. About 147,418 kg (325,000 lb) (wet) came from Maine in 2019, an enormous increase from 6,804 kg (15,000 lb) in 2015. Currently, most domestically produced seaweed is sold in health-food stores, select grocery stores, and some restaurants and food service companies (Piconi et al., 2020). Kelp is a great source of vitamins, minerals and antioxidants, it is low calorie, and full of fiber (Sappati et al., (2019). Seaweed is slowly growing in popularity as a mainstream ingredient for its health and taste (Piconi et al., 2020). For example, in 2020, Sweetgreen, a popular salad chain, collaborated with chef David Chang to create the Tingly Sweet Potato and Kelp Bowl, which used 9,979 kg (22,000 lb) of Maine’s Atlantic Sea Farm’s kelp (Carman, 2020). However, although growing, the popularity of kelp as an everyday food is one problem for developing the kelp industry. Continued product development and marketing that showcase the uniqueness of kelp will help grow this industry in Maine and the United States (Piconi et al., 2020).

Processors

Another bottleneck for expanding the kelp industry in Maine is the number of processors. Maine only has five seaweed processors of significant scale, and growers must determine where they will sell their kelp before it is even grown (Piconi et al., 2020). Raw, fresh kelp is highly perishable, so stabilizing it immediately after harvest is imperative (Sappati et al., 2019). First stage processing, like drying or freezing, and then final stage processing into value added products is not often feasible for a farmer, so oftentimes they form a contract with a processor, which will supply seed spools at a low or no cost, in exchange for buying a guaranteed amount of kelp. More processing infrastructure will help additional growers come online and expand the industry (Piconi et al., 2020).

2.3 Challenges facing small businesses

The disadvantages small businesses face poses additional challenges to new aquaculture operations. Especially in their infancy, small businesses may not have access to capital (Lazur, 2010; Barlett & Bukvič, 2001). For example, an individual looking for a \$100,000 loan to start a novel ear-hanging scallop venture may be deemed too risky by a bank. Furthermore, if financed, the production cost per scallop may be too high to make much profit, unless economies of scale are reached. Big businesses are able to have high levels of production and can often weather initial years of financial loss due to an easier time securing investments (Barlett & Bukvič, 2001). Furthermore, small businesses often cannot afford to sell at a low price to wholesalers, so they must enter retail or niche markets, which takes time and only moves a small volume of product. Farm sales, niche markets, small grocery stores and internet sales take more time, are more expensive, and are unpredictable (Lazur, 2010). It is necessary for a small business to think creatively to overcome these economic issues.

A marketing plan helps, but small businesses may not have the manpower to take time away from production. In the early stages, the farmer may juggle production, finances, research, product development, legal issues, human resources, and more, but taking on a new employee to develop a marketing plan - and carry it out - may not be feasible (Barlett & Bukvič, 2001). Furthermore, farming equipment for scallops and

processing equipment for kelp are a big investment, but necessary for higher prices and efficiency, especially for value added products. Equipment, time, labor, packaging, and refrigeration are not always feasible for a small farm (Lazur, 2010). With a small business, developing the farmed sea scallop and kelp industries in Maine may be impossible without a new way of thinking.

2.4 Challenges facing the Maine Aquaculture Co-op

The Maine Aquaculture Co-op (MAC), founded in 2016, is Maine's first aquaculture co-op. Its membership is composed of fishermen, aquaculturists, marketers, biologists, distributors, and more, all with the mission of developing scallop aquaculture in Maine. MAC has about fourteen active members and member meetings quarterly. They are currently transitioning board membership from founding members to new members who have joined the Co-op within the last couple of years. Originally the Co-op began as a way to raise funds through grant writing for aquaculture equipment. While this still holds true, the Co-op has evolved into a platform to push the scallop aquaculture industry forward for everyone.

The last four years they have established a loyal membership, shared knowledge and equipment, grown and sold scallops, and more. They are currently working on a cookbook to help chefs and home cooks navigate cultured scallops. However, with more but inconsistent product coming online, and lacking a cohesive marketing strategy, the co-op is at a crux. Members wonder what the co-op can and will offer one, five, or twenty years from now.

2.5 Research questions

The research questions asked were:

- What are the benefits of a co-op to its members?
- What are the challenges of a co-op to its members?
- What factors are there to consider when determining a co-op's structure?
- Could the co-op model help:
 - o increase scallop and kelp production?
 - o develop markets and products?
 - o move the industries forward through a landscape of small and limited producers?
- How can these answers best serve:
 - o the Maine Aquaculture Co-op?
 - o The kelp industries?
 - o Any aquaculture co-op?

3.0 Methods

To achieve a broad understanding of the co-op model, ten co-ops varying by age, commodity type, and size of membership were selected. Five of the co-ops were aquaculture, one was both aquaculture and fishing, two were specifically fishing, and two were agriculture. Co-ops and co-op members were determined through internet searches, key informants, and snowball sampling. They were recruited by contacting them in person, via email, social media, or by phone, and any that were willing to participate were used.

Due to the small number of co-ops, sampling was non-random and was either a volunteer sample or a snowball sample. A volunteer sample, also known as a convenience sample, is the opposite of a random sample. A random sample ensures each member of the population has an equal chance of participating (Beaudry & Miller, 2016; Clark, 2017). A snowball sample is when potential participants are suggested by subjects (Beaudry & Miller, 2016; Bernard, 2011)

3.1 Interviews

After initial research for background knowledge on the co-ops, interviews were conducted in person, by phone, or via video conference from February 2020 until June 2020 (appendix 1). Members and administrators were interviewed individually from nine co-ops, except in two interviews where partners interviewed together. In total there were twelve interviews and fourteen interviewees. One co-op was researched via text-mining, but no interviews were able to be conducted. The interviews ranged in duration from 30 minutes to two hours. Interview questions focused on the benefits and challenges of being in a co-op, why members joined the co-op and remained members, and what they see as the co-op's future or hopes they may have for the co-op. Seven of the twelve interviews were audio recorded; where audio recording was impractical (N=5), detailed written notes were taken for future analysis. A semi-structured interview is a conversation between a researcher and a participant where the researcher comes prepared with questions. The conversational manner allows the participant to explore important themes that may not be predetermined. Basing the interview questions on the literature helps the conversation stay productive and facilitates data analysis (Clifford et al., 2016) while the conversational manner allows the participant to explore important themes that may not be predetermined.

3.2 Text-mining

Following interviews, text-mining of nine co-op websites and twenty-six news and scholarly articles that mentioned the co-ops were used to find additional themes. One co-op that was not interviewed was researched in this way. Text mining is using a computer to discover new information, which may be linked together to find themes. It is different from a typical web search where information is already known, analyzed, and written about by someone else (Gupta & Lehal, 2009). Text mining for this project involved visiting co-op websites and recent and relevant articles to look for co-op benefits. Furthermore, I had access to one co-op's bylaws and shared equipment use policy and agreement.

3.3 MAC case study

In order to make specific recommendations to the Maine Aquaculture Co-op, in addition to interviews, participant observations and text-mining, I observed three member meetings and had access to four meeting minutes between October 2019 and May 2020. Meeting minutes are a valuable data source because at meetings concerns are shared, updates and decisions are made, questions are asked, and matters are voted on (Barnes, 2011). Additionally, I was included on co-op email chains between November 2019 and July 2020. I was also provided the responses to a member survey that was sent out in December 2019. The survey asked members what they find most valuable about the co-op currently, as well as what they see the co-op's role being in one and five years (appendix 2). Lastly, I conducted a survey on scallop production to determine current and future sales of market scallops and spat (appendix 3).

3.4 Participant observations

Lastly, to gather data on MAC and the other researched co-ops, participant observation was utilized at member meetings, co-op interviews, and aquaculture information events. Participant observation is the interaction of people - the participants - in their everyday life while collecting information. This was the most opportunistic of the data sampling. Frequently, information was not recorded in the moment to maintain the organic and normal environment. This method of data collection has roots in anthropology and sociology, and it is useful for assigning themes to the human existence, or, in this case, their existence within a co-op (Beaudry & Miller, 2016; Jorgensen, 2015).

3.5 Data analysis

To determine themes around benefits and challenges, the data was coded using both data-driven coding and concept-driven codes determined during literature review. Data-driven coding is the evaluation of initial interviews and observations for repeated concepts, while concept-driven codes are pre-developed during literature review (Cessada, n.d). The benefit of concept-driven codes, or *a priori* themes, is that it quickens the initial coding stage of analysis. Literature on co-ops is sufficient to safely assume certain themes discovered during literature review will emerge during data analysis. However, data-driven coding is important to avoid ignoring or overlooking themes during data analysis that were not determined during literature review. (University of Huddersfield, n.d).

Themes from literature review (*a priori themes*):

- Collective bargaining
- Vertical integration
- Shared personnel
- Grants and outside investment opportunities
- Knowledge sharing
- Economy of scale

These themes were used to prompt interviewees on the benefits they receive and co-op goals they may have. This was useful for some interviewees who knew their co-op offered a service, without previously understanding it as a benefit.

With data gathered through interviews, data mining, text analysis, and participant observations, themes were determined through analysis. Data analysis consisted of reading and re-reading the data and highlighting *a priori* themes determined during literature review, or repeated information that became new themes. Analysis continued with color-coding quotes or text that support the themes.

To ensure the reliability of the data acquired from the methods, information gathered from different instruments and from different participants was compared. This is known as triangulation of the data. If, in general, the same information is found from all sources, then the data has a high likelihood of validity. Transforming the data into themes also ensures its accuracy, and if the themes are consistent across measurement instruments, then it suggests the data is reliable. (Beaudry & Miller, 2016).

4.0 Results

4.1 Co-op descriptions

The following is a summary of each co-op used in this study and whether it is considered small (≤ 15 members) or large (> 15 members) and new (≤ 10 years old) or established (> 10 years old). Also see Table 2. The results continue with an analysis of each co-op factor, benefit and challenge (the themes). Lastly, the factors and themes are applied to the MAC case.

Co-op Name	Co-op Sector	Year Established	Number of Members	Location
New Meadows Shellfish Cooperative	Aquaculture	2020	12	Midcoast, ME
Georgetown Island Oyster Cooperative	Aquaculture	2020	13	Midcoast, ME
Maine Aquaculture Co-op	Aquaculture	2016	14	Downeast, ME
Noank Aquaculture Co-op	Aquaculture	2000	9	CT, NY
Ocean State Shellfish Cooperative	Aquaculture	2008	15	RI
Scottish Shellfish	Fishing/Aquaculture	1992	19	Scotland
Fogo Island Cooperative Society	Fishing	1967	53	Newfoundland, Canada
Seafood Producers Cooperative	Fishing	1944	530	AK, WA
New Roots Cooperative Farm	Agriculture	2006	4	Lewiston, ME
Agri-Mark Family Dairy Farms	Agriculture	1917	825	New England, NY

Table 2 Co-ops researched and relevant characteristics

New Meadows Shellfish Cooperative in Maine officially began at the beginning of 2020 as a producer co-op. It has twelve members who oyster farm in the New Meadows River and share equipment because of their proximity. The farms are within a seven mile range from each other. Their oysters are sold through various distributors and direct to consumer sales, and each farm maintains their individual brand. As the co-op grows, they hope to market their oysters out of state under the Co-op's brand. It is a small and new co-op.

Georgetown Island Oyster Cooperative in Maine began in March of 2020 as a producer co-op with plans to market and distribute. It has a unique structure with a shared equipment use agreement with the Georgetown Aquaculture LLC, which began in 2017. All the members of the LLC are farmers in the co-op, but not all thirteen co-op farmers are members of the LLC. The LLC received a substantial amount of money from a benefactor to purchase equipment and provide micro-loans to LLC members to be paid back over ten years. The LLC owns the equipment, but the co-op has access. The oysters are sold under the brands Robinhood Oysters and Eros Oyster, not under individual farm brands. It is a small and new co-op.

The **Maine Aquaculture Co-op** was described in greater detail later in the background of the report because it was used as a case study. The co-op began in 2016 to grow sea scallops and expand the market for sea scallops. It has a limited number of farmers who are spread out throughout Penobscot Bay. Currently only one farmer has product to sell. It is a small and new co-op.

The **Noank Aquaculture Co-op** began in 2000. It is a producer and marketing co-op with nine member farms in Connecticut and New York. The co-op sells market oysters with individual farm branding, and oyster, clam and bay scallop seed through a co-op member owned hatchery. It is a small and established co-op.

Ocean State Shellfish Cooperative in Rhode Island began in 2008 with six original member farms. It now has fifteen. Members independently grow oysters and some clams and then sell to the co-op which markets and distributes the products from the co-op owned central facility. It is a small and established marketing co-op.

Scottish Shellfish, is a marketing co-op with nineteen member farms on the west coast of Scotland and the Shetland Islands. Its members primarily grow mussels, but two members, including the individual interviewed, grow oysters. It also distributes brown crab and Maine lobster. Products are sold under the co-op brand, Scottish Shellfish, primarily to grocery stores. All transportation, processing, marketing, and distribution is co-op run, while farming is independent to the farmer. It is a large and established co-op.

Fogo Island Cooperative Society, began in 1967 on Fogo Island, Newfoundland. It was born out of a push for island resilience instead of resettlement on the mainland. The fishing co-op has 53 members, three plants and a head office on the small island. They fish, process, market and sell nationally and internationally ground fish, pelagics, snow crab, sea cucumber, scallops, mussels, and shrimp. It is a large and established co-op.

Seafood Producers Cooperative was founded in 1944 and it is North America's oldest fishermen's co-op. The co-op's sales office is in Bellingham, Washington and the processing plant is in Sitka Alaska, where almost all of the 530 members are based out of in the summer. The co-op fishes mainly for coho and king salmon, halibut, albacore tuna, and sablefish using hook and line. It is a large and established marketing co-op.

New Roots Cooperative Farm, began in 2006 in Lewiston, Maine by four Somali refugees. It is a producer co-op that sells directly to consumers through a CSA (Community Supported Agriculture) and farmers markets. It also sells wholesale to food pantries, restaurants, school and retail stores. It is a small and established co-op.

Agri-Mark Family Dairy Farms began in 1916 under the name New England Milk Producers Association. In 1980 it took on its current name, and in 1992 merged with Cabot Creamery Co-op. Farmers in New England and New York sell dairy to the co-op for processing, marketing and distribution. The co-op has 825 member farms, making it the largest co-op in this study. It is a large and established marketing co-op.

4.2 Co-op factors

Four factors emerged that dictate the purpose or function of a co-op: 1) whether the co-op is a distributor; 2) whether it keeps the member's brand; 3) if members are required to sell through the co-op; and 4) how geographically close the members are to one other.

1. The co-op is a distributor

The co-op has the certification to sell directly to restaurants/grocery stores/consumers and doesn't first sell to a wholesaler.

The two aquaculture co-ops that are small but established are focused on distributing oysters. Member farms are required to sell through the co-op, but as individual brands. The members are not selling through a local distributor, like Glidden Point or Maine Oyster Company in the case of Maine. The four large, established co-ops researched operate as a distributor. All the co-ops buy milk, oysters, fish, and other seafood from their member boats or farms and process it in co-op owned facilities. The products are sold by the co-op to stores, restaurants, or wholesalers. In order to get their product to market, they do not rely on an outside distributor. A small, recently established co-op identifies as a growing and a selling co-op, and one of its members is a certified shellfish dealer who does all the marketing and selling for the co-op. However, members do not have to sell through the co-op. Another small and new

co-op hopes to build their own distributing facility instead of each member having their own or selling to another proprietor. A farmer from that co-op stated: “Right now we’re working on a facility where we can deal directly with restaurants rather than each individual having their own facility. They can go through the co-op... It just needs to be a place where we can retag the oysters so they can go from the farm directly to the restaurant... it allows for more distribution directly to restaurants.” The inability to operate as a distributor does not necessarily impact the co-op’s success, but it does dictate the focus and purpose of the co-op.

2. Co-op or member branding

An important factor to how the co-op and its members operate is whether the product sold maintains the brand of the member farm, or whether it subsumes the co-op’s brand.

All of the four large and established co-ops aggregate member’s product and sell under the co-op’s brand. Three of these co-ops have over fifty members and are either fishing or dairy cooperatives. Individual branding is challenging and not as important for these products. However, a member of a large fishing co-op said that as fish marketers begin to add boat-to-fish traceability, demand is rising for such a thing. Tracing a fish sold to the boat that caught it is currently impossible for a co-op that pools all fish. However, the co-op recently allowed members to sell some fish at farmer’s markets.

In Maine, people buy oysters from different farms for their unique flavors, like wine from different regions. In the UK, where one of the co-ops is located, consumers do not care specifically where an oyster was farmed. Therefore, the co-op sells the farm’s oysters under the co-op’s brand. However, the oyster farmer for this co-op wishes that at times like now, during a pandemic, he could build up his brand and do mail orders.

For a small and established oyster co-op, individual farm identity is important to its members. The member interviewed, who started the co-op, says newcomers will not join unless they can sell under their own brand. Another small and established shellfish co-op also sells using individual farm names. For two small and recently established co-ops, the members share space for production - either a lease site or a plot of land- and therefore do not sell under individual member brands.

3. Required to sell through co-op

Some co-ops require members to always sell to the co-op, some have specific exceptions for direct to consumer sales, and some do not require members to sell through the co-op, but members will not receive certain co-op benefits.

A large and established aquaculture and fisheries co-op requires members to always sell to the co-op with zero exceptions. A large and established dairy co-op requires all milk to be sold through the co-op, except some cheese or other products, which can be sold to consumers but not another handler. Alternatively, a large and established fisheries co-op does not require members to sell through the co-op because co-op owned tenders are not always available and it is up to the member to decide how much to pool towards a potential retro check or dividend. A retro check, or retroactive pay, makes up the difference between what a member was paid for pooling their product and what they would have made for cashing out at the dock. However, for the first year, members are required to sell a certain amount to establish their membership. For a small but established co-op, members must sell through the co-op, and for another small but established co-op, members don’t technically need to, but they won’t be given ice, bags, boxes, or any help. For a small but new co-op, members can sell lower-grade oysters unbranded, but all market oysters go through the co-op.

4. Geographic proximity

Some co-ops operate from one space, as is the case with one interviewed agricultural co-op where four members share a farm. However, many co-ops interviewed have individual member farms. A factor that dictates what benefits the co-op can provide or what role the co-op may serve is whether the members share one space, or, if they do not, how far apart the farms are from each other.

For co-ops where members have member owned farms, how close the farms are to each other is an important factor. Two of the small and new co-ops have member farms that share a cove or a river, allowing for easy sharing of equipment. A member of one of the small and new co-ops cited proximity as a benefit because if other areas experience closures, members can still share equipment. In the case of closures, a member from a large and established co-op said that being spread apart is important. If farms in one area are closed, the co-op is still able to sell mussels from other farms. The co-op has its own fleet of trucks to bring product from the farms or boats to the processing site, so being spread apart is less important. A small and established co-op has member farms in a twenty-five mile radius so oysters are easily brought to the facility for processing and shipping by its own farmers. This is important for a co-op that does not have its own trucks to transport product from farms or docks to the processing site.

4.3 Co-op benefits

The benefits of the co-op business model identified through data collection efforts were grouped into the following ten themes (figure 3). The order is random.



Figure 3 The Ten Benefits of the Cooperative Model and specific examples from the research

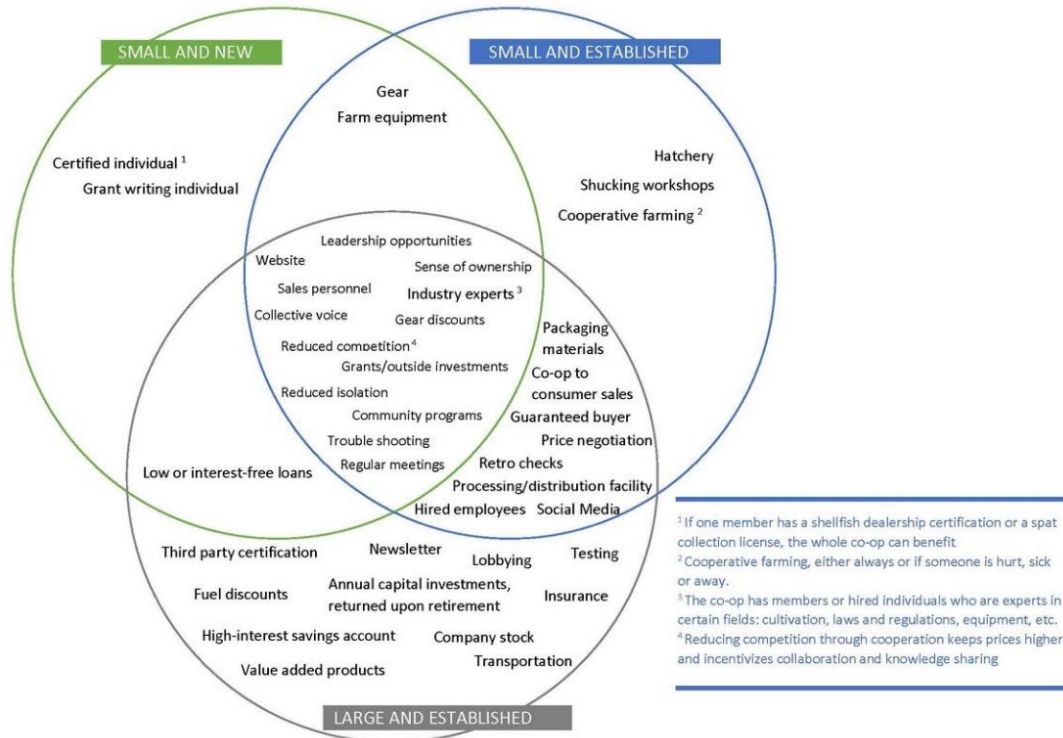


Figure 4 Benefit subthemes organized by size and age of cooperatives researched.

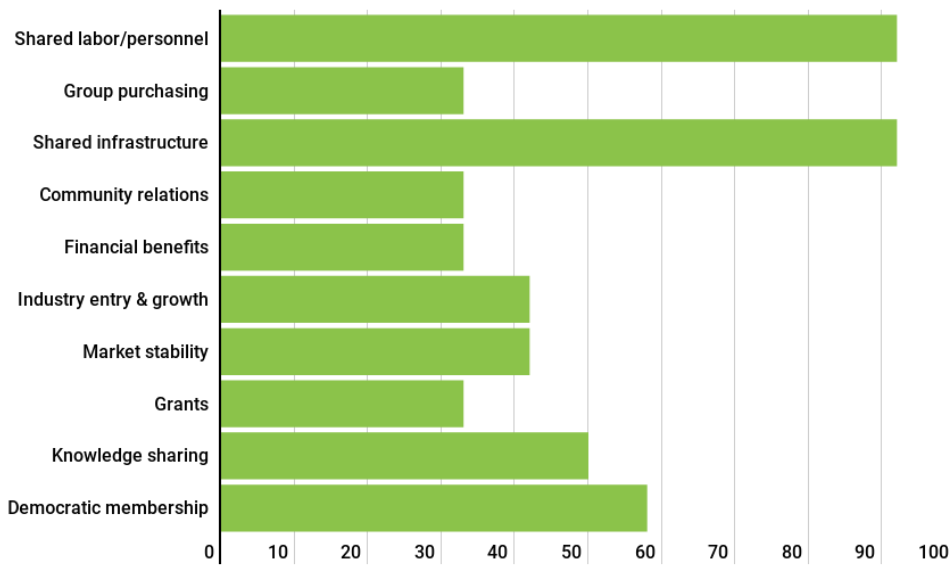


Figure 5 Percentage of interviews that mentioned the benefit

1. Shared labor/personnel

The co-op members each take on or share the work of different tasks, or the co-op can hire people to complete different tasks. The key here is through shared or hired labor, members have more time to farm or fish, or benefit from knowledge or expertise they may not otherwise have access to.

Labor and/or personnel are shared with all co-ops, per the definition of a co-op (Frederick et al., 2016). In eleven out of twelve interviews, shared labor or personnel was mentioned as a benefit (figure 5). With a small, recently established aquaculture co-op, interview results showed a casual distribution of labor based on member's skills. One member applied for a grant for a water quality test, another is more comfortable building boats, while another designed the website. An interviewee of a small, new co-op stated, "as a small farmer you have to do all these different aspects of running a business and a lot of us don't have those skill sets." It can also be more formalized, like with a much larger (members > 100), well established co-op, where the co-op is staffed by hundreds of employees and thus the members are sharing personnel. The co-op contracts out tenders for the boats to unload their fish, they have co-op owned processing plants, a marketing team, all the infrastructure and employees you'd expect from a fully integrated company, except it's all member owned. This benefits the fisherman because, as the website for the Seafood Producer Cooperative states, "It is very rare that fishermen can concentrate both on fishing and on selling their product". A small but established aquaculture and fishing co-op is similarly integrated. Once the product is grown or caught, the co-op deals with everything else: "I think it's a brilliant thing because what it really allows you to do is sit and focus on growing the oyster and most of the members of this co-op are in very rural areas and they [the co-op] look after the distribution and all the help, all the safety testing, the packaging, the marketing is all done by the co-op, by the factory and we can just concentrate on the growing" (farmer, large, established co-op). Whether the co-op has the means to hire on a few employees, zero, or hundreds, sharing labor or hiring on staff results in increased efficiency.

2. Group purchasing

The co-op buys the inputs (bags, boxes, ice, fuel) for the members to use or for the members to buy at a discounted price.

Co-ops allow for group purchasing of inputs, which can help save money through bulk discounts, or time because someone else is dealing with the inventory and purchasing. Four of the interviews mentioned group purchasing as a benefit (figure 5). A small and recently established co-op is currently in the process of ordering a container's worth of gear from an international source, which will save members money and possibly time. More experienced members are able to give input on how much to buy - and what. They can also have more control over what they get than if they bought through a supplier in the United States. A small but established aquaculture co-op supplies its members with ice, onion bags and boxes, creating convenience for the member. A large and established fishing co-op provides its members with price breaks on fuel, gear and bait. This may be possible through bulk discounts (Kauffman, 2017).

3. Shared Infrastructure

The co-op members share physical spaces/equipment. Members either all contribute to the one-time purchasing of expensive equipment/land/buildings/boats they would otherwise be unable to afford, or they have access to the infrastructure by joining an established co-op.

Eleven out of twelve interviews claimed shared infrastructure as a benefit to the co-op (figure 5). A small and recently established agricultural co-op shares the same land, farming equipment, and eventual farm stand. The four members started the co-op, so they collectively came up with the funding for the infrastructure. Alternatively, members of a small, established aquaculture co-op share a processing facility, but individually own their farming equipment. Similarly, a large and established aquaculture and fisheries co-op does not cooperatively share farming and fishing equipment - the production side - but owns shared refrigerated trucks for distribution, processing, and product safety testing capacity.

4. Community Relations

The co-op can benefit the local or broader community and a co-op can help with community relations and public perception, both locally and nationally. For example, tackling Not-In-My-Backyard (NIMBY) issues as a co-op may be more effective than as an individual.

Four of the twelve interviews discussed community relations as a benefit, or benefiting from, the co-op (figure 5). One of the co-ops interviewed only accepts members who are residents of the town where the co-op is situated. Literature review shows that a co-op supports a community through jobs and taxes, and, unlike a business owned by one person, an individual cannot take a co-op away from a community or shut it down (Frederick et al., 2016). A co-op that is community run will stay in that community (Frederick et al., 2016). Furthermore, co-ops may help quell community objection to aquaculture. A member of a small, recently established co-op stated in an interview, “there are a lot of people on our board who have a lot of property around so they’re getting their perspective and communicating that to others”. This may be helpful for securing leases, which requires community input as part of the mandated leasing process.

5. Banking

A co-op is a pool of people so it may be able to act as a bank/insurer with the member’s interests in mind, since it is member owned.

Four of the interviews mentioned banking, loans, insurance, or some form of financial assistance as a benefit offered by their co-op (figure 5). A large, established aquaculture and fisheries co-op that was interviewed does not require an annual membership fee, but requires a levy on product sold to the co-op. The levy accumulates through member contributions and can be used for operation of the co-op or accessed by members as a zero-interest loan. When an interviewee took over his father’s farm, he was able to use the money from his father’s levy to buy oyster seed. Another large and established co-op offers a similar benefit. The Marketing Manager stated “... members invest ten percent of their gross settlements as capital investment in the company to a maximum of \$15,000. The capital represents ownership in the company and is used to finance day-to-day operations. When the owner/member retires, they get this amount paid out in equal amounts over three years.” The same co-op offers various types of insurance, including wooden boat insurance that would otherwise be very challenging to acquire. Finally, many established co-ops interviewed offer year-end retro checks or dividends. A large and established fisheries co-op may pay less for member’s fish than dock price: “you get less now but it's like savings for the winter and you hopefully still earn more and go over dock price so you'll make even more than if you just sold and cashed out at the dock in the summer”.

6. Industry entry and growth

New farmers or fishermen can get into the industry because gear/equipment/distribution channels/knowledge is available. The co-op may also advocate for industry changes/rule changes that help farmers/fishermen whether they're in the co-op or not. The co-op may also drive demand for new products, which non-members can benefit from.

Five of the interviews discussed industry growth and ease of entry as a benefit of their co-op (figure 5). One of the small but established co-ops interviewed offers shucking workshops to encourage consumers to buy directly from the co-op and not just through a restaurant. This may help with demand and ways in which people can enjoy oysters. A small and new agricultural co-op offers farming workshops for immigrants or new Americans who are learning how to farm, helping facilitate industry entry. A large, established fisheries co-op sends members to Washington DC for citizen lobbying to help young people enter the fishing industry.

7. Market Stability

The co-op can help control the price through price negotiation power, they may have a guaranteed buyer, and because the members are working together, they aren't driving the price down through competition.

Five of the twelve interviews mentioned some sort of market stability as a benefit of their co-op (figure 5). Market stability is mostly a benefit to larger, more established co-ops who process and distribute product. However, one member of a small and new oyster co-op hopes that if too many farms start selling and the price falls, that as a co-op they'll be able to collectively ride that out. A member of a large dairy co-op stated market stability as the number one benefit of the co-op. He has a guaranteed buyer and was able to sell milk during a time when independent farmers could not. With covid-19, market stability is extremely important to an oyster farmer from a large, established co-op. When the market is good, the co-op will buy from members and independent farmers, but when the co-op is barely selling to grocery stores, they will only buy from members. He states, "We've sat and watched other people work the market better and maybe come away with a slightly better price at times, but the stability really comes into play particularly at times like now. I'm the only one selling any just now, and it's small money but it pretty much will cover our wages, so that's something to be really thankful for." The manager of a small but established co-op stated that with covid-19, wholesalers really want to buy at a lower price, but he's holding firm on what he'll sell for. Since he speaks for multiple farms, he has sway over the price.

8. Grants/outside investments

It is easier to secure investments or grants as a co-op. A funding agency may look more favorably upon a group of farmers than an individual.

Four of the interviews said that grants or outside investments were a benefit of their co-op (figure 5). All the co-ops are small and three were recently established. One aquaculture co-op applied for a grant to buy equipment, and another aquaculture co-op received a grant to do a water quality test and is waiting to hear back from another grant for a piece of infrastructure.

9. Knowledge Sharing

Members aren't in competition with each other, so knowledge sharing may be more plentiful. Knowledge sharing can be informal chats, member meetings, conferences, newsletters, etc.

Half of the interviews claimed knowledge sharing, in any form, as a benefit of their co-op (figure 5). According to a member of a small and recently established aquaculture co-op, the co-op model fosters communication: "You're really isolated as a small farmer, you don't get to interact with what people are doing and see what's going on... knowledge sharing, reaching out and seeing what's going on." It was observed that a lot of knowledge sharing occurred during a member meeting of a recently established aquaculture co-op that is growing a species only recently cultivated at any scale. It was a time to problem solve, provide advice to newer growers, and swap frustrations or successes.

10. User ownership and user control

This is both a benefit and a challenge due to all the voices being heard. According to the user-owner principle, members own the co-op and should contribute financially equal to how much they utilize it. According to the user-control principle, members control the co-op through voting and participation on the board.

Seven of the twelve interviews mentioned user ownership, user control or democratic membership as a benefit and a challenge of their co-op (figure 5). The business is controlled by the members and not outside investors, so decisions may be best for the members, but agreeing is challenging. A member of a small, new co-op stated that an owner of a company can dictate the direction and the plan, but a co-op needs to share the different directions members might want to go in. It involves more persuasion, dealing with the different personalities, and weeding out "jerks" as one member put it. Also, for smaller co-ops in particular, some people may end up doing more work. This is a concern of an interviewee of a small, recently established co-op, and an observation made of other co-ops. The "group-project dilemma" seems to be more common in small, new co-ops, while larger co-ops have hired employees or a larger pool of enthusiastic volunteers for the board, leaving alone those who just want to farm or fish.

4.4 Co-op challenges

The three main challenges expressed during interviews are cooperating and agreeing, profits and the market, and the issue of member versus co-op branding.

1. Cooperating

Seven of the interviewees mentioned agreeing, working together, and cohesiveness as an issue currently, in the past, or to be wary of. The manager of a small and established aquaculture co-op stated that personalities of new farmers and their lofty expectations for prices is sometimes an issue. Additionally, when asked about identifying the key to a successful co-op, the founder of a small, established oyster co-op stated that not having "jerks" was most important. A member of a small and new co-op said that in the past, cohesiveness had been an issue. The co-op wasn't successfully established until it was attempted with a group of unified farmers.

2. Returns

Money was another concern mentioned by three interviewees. A fisherman for a large, established co-op stated that some members have debated leaving the co-op because they are unsatisfied with the returns. In this co-op, a first-year member needs to pool their fish with the co-op instead of just cashing out at the dock. This ensures money for the co-op's operation but results in less money upfront for the fisherman. If it is a financially successful year, the fisherman will receive more money in the winter, in the form of a retroactive check, than the fisherman would if they sold their fish at the dock. For the interviewee and her partner, their first year was a bad year for the co-op, so they struggled financially.

A farmer for a large, established aquaculture co-op described his co-op as a means to sell the product, not as a way to get rich: "The problem is I would say with a co-op is once it starts to do well there's always this sort of desire to demutualize, or people start getting interested in it as business and I think that should be avoided at all costs because ... it's a vehicle you use to sell your product, it's not like a business, you can't really realize that asset". This challenge is both a concern about profits and a disagreement about the co-op's purpose.

3. Branding

Lastly, the issue of member branding versus co-op branding was brought up by four of the researched co-ops. Members of a small, new aquaculture co-op are concerned about whether their oysters will be aggregated and sold under the co-op's brand, or if farms will maintain their identity. A farmer stated in an interview: "I think that's really what a lot of the people who are entering this co-op are concerned about, they're a little bit worried about losing their brand. You see this logo - this [farm] logo - and you see this name - this [oyster] - and people are latched on to that, they love those oysters. It's just we would continue to push our brand and if we have the [co-op] we're still going to have our brand". Furthermore, the founder of a small, established aquaculture co-op stated that she can't persuade new members to join if they can't sell under their own brand. They must sell through the co-op and transactions pass through the co-op, but members have their own accounts and sell using their farm's brand.

Alternatively, a large, established aquaculture co-op sells member's oysters using the co-op's brand. The farmer interviewed is only able to sell to the co-op, and therefore has not established much of a brand or presence on social media. This farmer was interviewed after Covid-19 began and he stated: "So you have no identity, that's why I don't have much of a website, I don't need that. The last thing you want to do is collecting inquiries if you know what I mean. I think you lose a bit of the fun of building this sort of brand and your own identity... there are times when I'd like to build up my brand and times especially like now where I wish I did mail orders or something like that".

There is some consumer demand for traceability of fish from a large, established fisheries co-op, which would only be possible if fish was tied to individual boats. However, fish in this co-op of over 500 boats are aggregated. According to a fisherman interviewed: "One issue that has been coming up lately is we're selling co-op fish and some people really want to know exactly what boat it comes from because, first of all, it's cool to know what boat it comes from, but there are other fish marketers who are making a big deal out of this like 'know what boat it came from!' and there's a QR code you can scan on the fish and it'll tell you about who caught it and it's like, I see where that's coming from but I think that's a little overkill because knowing what boat it came from, if that's all you know, that doesn't really tell you anything". However, recently members are able to sell some of their own fish at local farmers markets, which provides that face-to-fish traceability consumers enjoy.

4.5 The Maine Aquaculture Co-op

The Maine Aquaculture Co-op's structure is unlike any other co-op researched. My impression is that it is a co-op aimed at growing the overarching scallop aquaculture industry (benefit 6) through sharing knowledge (benefit 9), sharing some equipment (benefit 3), and buying difficult to acquire gear (benefit 2), but scallop production is still quite minimal. According to a survey on scallop production (appendix 3), of seven, only two MAC producers are currently growing and selling market scallops, one is selling scallops through the distributor he owns, one member is selling scallop spat, and four members plan to sell markets in the next two years (figure 6). According to the member who owns the distributor, one of the biggest marketing challenges is inconsistent supply. For the moderate amount of market ready scallops, MAC does not distribute scallops directly to stores, restaurants and consumers (factor 1). Scallops are either sold directly through a member farm's website or sold to a distributor. However, like other small, new aquaculture co-ops researched, one of the members is licensed to distribute and sell product, streamlining the process (benefit 1). The currently producing and selling member sells to this member's business. Product does not pass through the co-op, because the co-op is not licensed and does not currently have the infrastructure to sell and distribute seafood. For all six established co-ops researched, product is sold to the co-op, which processes, markets, packages, and sells the oysters, dairy, mussels, or fish for its members. As scale grows, there is interest from an MAC member in the co-op offering joint marketing, sales and delivery (benefit 1 & 3), which may evolve into the co-op acting as distributor. Forty percent of members responded in favor of the co-op facilitating product sales and distribution (figure 5).

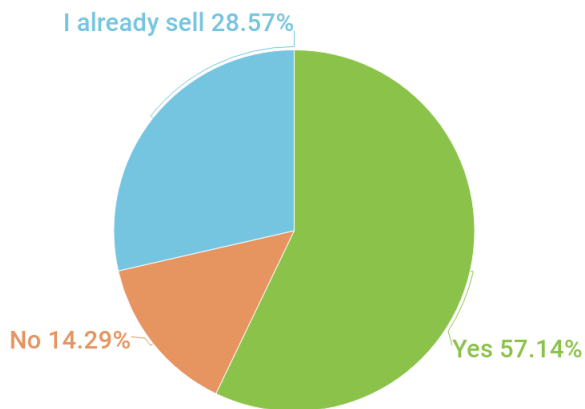


Figure 6 Number of MAC scallop farmers that are currently selling market sized scallops, plan to sell in the next two years, and do not plan to sell in the next two years.

From interviews with other co-ops, marketing oysters using the member farm's brand is very important to small co-op members (factor 2). However, it is unclear how necessary individual branding is for scallops. Currently, consumers can purchase one MAC member's scallops from their farm's website. The other scallops pass through a distributor unbranded. With more product online in the next two years, farmers need to decide if maintaining their farm's brand is a priority. Although the survey (figure 7) did not ask about farm versus co-op branding, 80% of respondents are in favor of building the Maine farmed scallop brand.

Compared to some co-ops that share a small bay, MAC's farms are far apart (factor 4). This poses some challenges and opportunities. Prior to Covid-19, meeting in person for meetings or events was challenging with ferry schedules or long drives from Down-East. Furthermore, sharing equipment is more difficult with spread out farms (benefit 3), and, down the road, collectively processing and distributing will be a challenge to achieve without a strong transportation network (benefit 3). A benefit of the dispersed farms is in the event of a closure. Like how one of the large and established co-ops has a consistent supply of mussels despite closures in some

areas, MAC protects itself from total closures in the event of toxic blooms or storm events (benefit 7). This is only a benefit if product is pooled through the co-op.

A huge benefit of the co-op is the diversity of members and their skillsets (benefit 1). Many are originally or currently commercial fishermen, one member owns an oyster farm and is licensed to distribute shellfish, and another is the communications manager. The secretary excels at grant writing with her academic background, the founder is an attorney by trade, and a member is the director of programs and research at a local nonprofit organization focused on science education and research. By sharing responsibilities, more gets done. For example, three members - two farmers and the communications manager - are putting together a scallop cookbook, and all members provide ideas and help promote it. The communications manager is also updating the website with member bios and locations of their farms. The licensed shellfish distributor pushes the co-ops scallops and communicates what the market wants and what would help grow demand. Furthermore, at least one member collects and sells spat, which members, and nonmembers, could benefit from. Industry growth is further supported by increasing access to spat (benefit 6).

Furthermore, through input from farmers, the secretary is bulk ordering gear (benefit 2). For scallop aquaculturists in Maine, acquiring lantern nets, spat bags, ear hanging supplies and other gear is challenging, expensive, or there are limited options given that the industry is in its nascent stages of development. Gear and equipment are often sourced from Asia. To save money and increase selection, MAC is currently ordering a container from Japan. For multiple members, this is mentioned as a major benefit to the co-op. Furthermore, in the past the co-op has sold extras to nonmembers, increasing access to gear for others in the industry (benefit 6), and generating some revenue for the co-op. The challenge of group purchasing is the time invested and necessary storage space, either for the actual container if it is purchased or all the gear inside.

Scallop production among members is limited and slow to increase, possibly in part because access to expensive equipment is challenging. Through grants and borrowing from members and nonmembers, the co-op has access to a sorter, a washer, a net washer, and a starwheel (benefit 3). Two member farms are about five miles apart and can share a scallop sorter brought up from Damariscotta. The farm that owns the sorter, has access to and has used a washer, and there are plans to share the washer among all members. Another member may be purchasing an automated ear hanging machine and is willing to let members use it. However, the biggest challenge to sharing gear is that the farms are not very close together, which is logistically challenging and potentially a biosecurity risk, especially in the event of closures. Furthermore, one interviewed member said that as scale grows, sharing the limited equipment will be difficult. However, she still cited equipment sharing as one of the biggest benefits to joining the co-op, and 80% of reporting members cited securing equipment to share as something the co-op should continue to do (figure 7).

Furthermore, unlike the other two small and new co-ops researched, MAC does not operate within one town or community. However, it does benefit the community of Maine fishermen (benefit 4). The Maine Aquaculture Co-op benefits commercial fishermen by diversifying their livelihoods and potentially supporting wild scallop populations. Lobstermen and lobstering are so important to Maine's communities and its waterfront politics, so it is helpful that MAC's membership consists of many commercial lobstermen. The members want to see lobstering and aquaculture succeed in tandem. MAC members understand the uncertain future of lobstering, and therefore, according to the MAC website, hope to "maintain our robust working waterfront, and strengthen our coastal communities." Furthermore, regarding scallop farming techniques, members are transparent with scallop fishermen to minimize competition. At least one member collects spat over muddy and unsuitable substrate, so they are not removing viable spat. Additionally, as farmed scallops mature, the hope is that they will spawn and seed the bay. Any unused collected spat, which has been cultured into a much more robust size, is released back into the ocean, potentially benefiting the wild population. Lastly, the co-op is discussing the possibility of inviting fishermen to collect spat, which members will buy.

Through knowledge sharing (benefit 9), MAC is helping members incorporate aquaculture into their own communities (benefit 4 & 6). As aquaculture grows in Maine, so do conflicts with riparian landowners. Two MAC members, who own a farm together, are in the process of securing a standard lease. During multiple meetings leading up to the scoping session, conflict with the riparian landowners was brought up, and members provided advice on minimizing complaints from homeowners and fishermen and smoothing community relations. One suggestion was to change buoy colors to blue and green to help camouflage the farm from the shore. To appease fishermen, it was recommended that they spread out the farm to allow fishermen to fish in between longlines. Members offered MAC support at the lease hearing and suggested showing a picture of another member’s farm of similar size to quell homeowner fears.

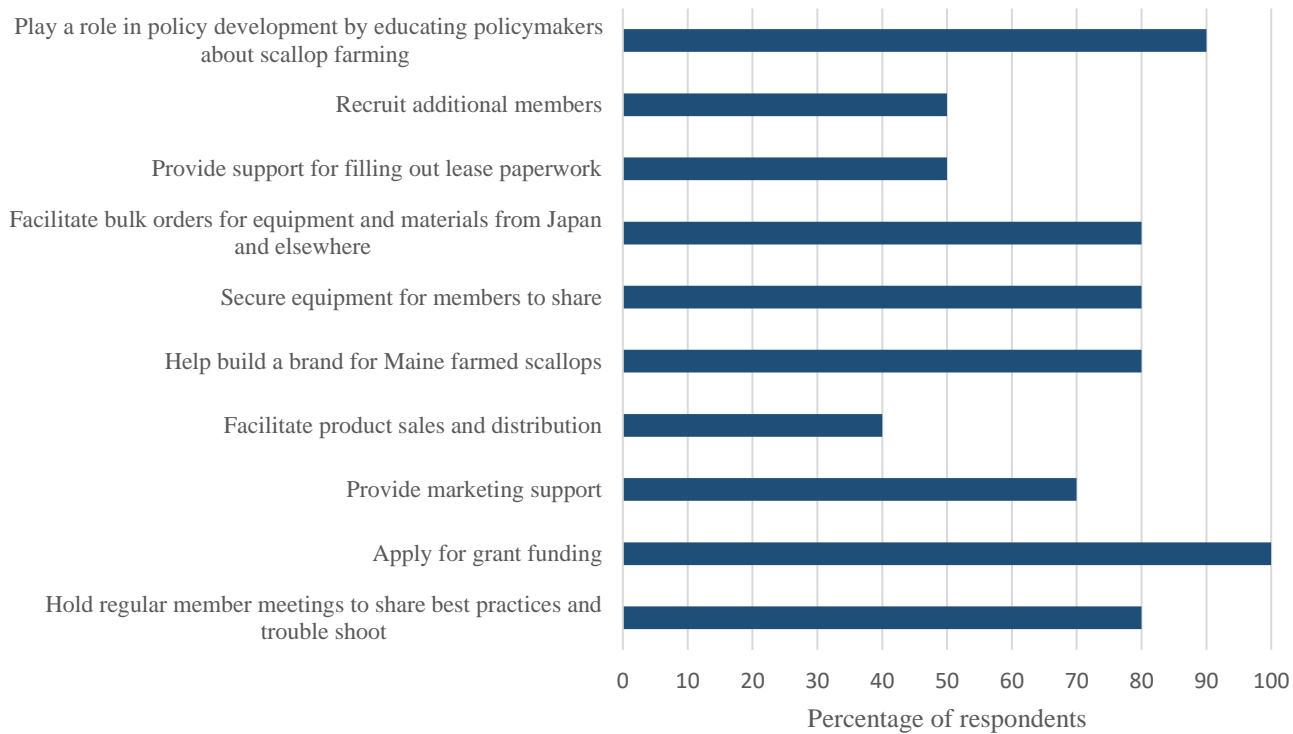


Figure 7 Responses to the survey question ‘What activities should the co-op continue and/or begin to pursue... (check all that apply)’

5.0 Recommendations

In the recommendation section I provide short-term and long-term recommendations for the Maine Aquaculture Co-op, recommendations for establishing a new co-op using the kelp industry as an example, and broader recommendations for future co-op developments.

5.1 For MAC

With its minimal, but growing, production of scallops, diversity of membership, multiple coinciding projects, and unified goal to develop the farmed scallop industry, the Maine Aquaculture Co-op is behaving more like an alliance or an association than a cooperative. Associations and alliances are groups of people or companies loosely organized under the same cause (Merriam-Webster, n.d.). With so much to achieve to be able to farm scallops - gear ordering, equipment acquisition, problem solving and knowledge sharing, market development, policy changes, and more - the disjointed nature of the co-op is not surprising. Based on my

knowledge of successful co-op's and the status of MAC, these are the recommendations for the short term and for the long term (figure 8).

1. Determine your structure

There are marketing co-ops where members independently grow a product and sell it to the co-op to be marketed and distributed. If it weren't for the need to share equipment, this is an appealing model for the MAC because the farms are geographically spread apart. There are producer co-ops that only help each other produce, either through equipment sharing or by actually sharing land or lease sites, and then sell the product to a third party. Then there are producer co-ops that are fully integrated. If MAC members are serious about growing and selling scallops under the co-op structure, and not just talking about growing or doing it totally independently, they need to pick an established structure before more members come online with product to sell.

Short term

My recommendation in the short term is that MAC should operate like the smaller, established aquaculture co-ops, except with more cooperative farming. To the degree possible, members can share equipment (factor 4). However, with a solid business plan, the co-op should help members find investors who can help individual farms, or clusters of geographically similar farms within the co-op, finance the expensive equipment. With farmers independently producing, the co-op should establish a central distribution facility with the necessary certifications. This is only achievable if MAC can establish a clear business plan for banks or lending agencies. Like one of the small, established aquaculture co-ops, the facility could be run by the only paid employee of the co-op. This individual should be marketing minded and tireless until the co-op can afford additional employees. This employee will also oversee buying ice, farming gear, and shipping supplies for members. To ensure consistent product, members should be required to sell through the co-op (factor 3). If farm identity is important to members that can be maintained (factor 2). However, a market study is needed on whether individual farm branding of scallops is important to consumers as it is with oysters. To help finance some of the operation, the co-op should continue to source farming gear and equipment overseas and sell it to members and non-members with a discounted rate for members. Furthermore, in addition to market scallops, members can continue or begin to collect and sell spat to members and non-members.

Long term

In the long term, MAC should operate like the large, established co-ops from the research, with some variation. MAC could operate as one large cooperative with a membership of individual farms and small producer co-ops. It needs a central processing and distribution facility that buys product from farmers and co-ops (factor 1), and it needs co-op owned refrigerated trucks to transport scallops to the facility and out for distribution. It would benefit from co-op run quality and biotoxin testing capacity to preserve the consumer's faith in the product. There should be a marketing and sales team to determine new markets and products, work with wholesalers and restaurants, and bargain the price on behalf of the farmer (challenge 2). All scallops will be aggregated under the co-op brand (factor 2), and members will be paid fairly for scallops and will receive dividends based on how much they sold through the co-op. Members will not be required to sell through the co-op, but they will not receive any of the benefits and a smaller dividend (factor 2).

2. Establish a firm membership

MAC needs to formalize the co-op through paying dues and establishing a clear membership. Based on a membership structure borrowed from a small, recently established but very business-oriented aquaculture co-op, MAC should have three levels of membership. Farmers, or producer members, must be currently farming or hold a license or a lease to farm. Members may be individuals or farms and they will have one vote per individual or entity at member meetings. An issue MAC has is a lot of maybe members who no longer come to meetings, even if they paid dues or not. Therefore, prior to becoming a producer member, farmers must fulfill one year as a probationary member. After the year, the probationary member will need to be voted into the co-op and pay dues. This will weed out people who are not fully committed or do not have cohesive personalities and goals (challenge 1). Lastly, MAC has a lot of valuable members who are not farmers. These people will be advisory members who will volunteer their expertise based on the goals of the producer members. They can contribute to discussions and be on the board, but not vote.

In addition to clearly establishing a membership, MAC must work to recruit additional producer members. In the membership survey (figure 7) 50 percent of respondents did not want to recruit new members. However, consistent and adequate supply of scallops is limiting the growth of the market. Four MAC farmers are one or two years away from selling scallops, which will help, but recruiting more members who are currently producing will contribute to the necessary scale. Recruitment efforts should focus on farms that are geographically close to another farm, to ease equipment sharing (factor 4). If these members are fully engaged with the co-op, there is no limit to how many members could join, but based on the research, the initial goal should be ten to fifteen members (challenge 1). After all, not all established co-ops have a large membership. While some of the co-ops researched had hundreds, the successful aquaculture co-ops had under twenty member farms.

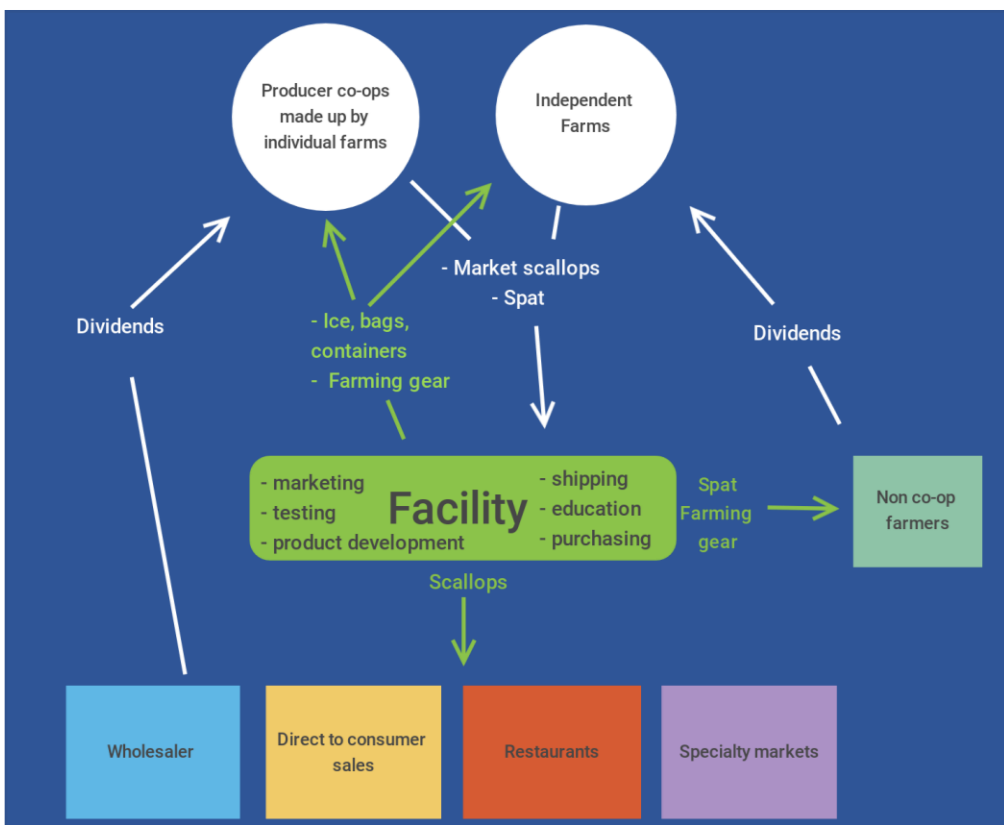


Figure 8 A visual of the proposed recommendations for the Maine Aquaculture Co-op

5.2 For a kelp co-op

Currently there are no kelp cooperatives in Maine. With an understanding of the kelp industry and its challenges, the following is a recommendation for a kelp cooperative structure (figure 9).

1. Processing

Kelp farming is a low maintenance, low value and inexpensive venture, often providing supplemental income for the farmers. Therefore, a producer co-op with a focus on shared equipment and farmer support is not necessary. With processing as the bottleneck for the industry, a member owned processing facility making value added products would support the growth of the industry. The first step would be to establish a large but loyal membership to achieve scale. If it is possible to source seed spools elsewhere, the first focus of the co-op would be to create a facility for first stage, and eventually final-stage processing. Capital for a processing facility would come from investments and co-op fees. The co-op structure may help facilitate outside investments since the money would benefit many. Furthermore, the initial investment from new member fees and annual co-op fees will help establish and run the facility.

2. Hatchery

The next step would be to create a co-op owned hatchery, like other kelp processors in Maine and one of the small, established aquaculture co-ops researched. With a hatchery, the co-op would be fully integrated, and members would have control and ownership over the entire process. Profits from processing value added products would be reinvested into the co-op via the hatchery.

3. Product development, marketing and sales

With ample kelp and a processing facility, the next hurdle would be growing demand for kelp products. Kelp is just beginning to become familiar to the average American consumer, so creative product development and a strong sales and marketing team is critical. Unlike scallops, which largely speak for themselves, kelp's potential in products is essentially limitless. A co-op run marketing team would establish what consumers want, communicate to them what they don't yet know they want, and put those products into grocery stores and popular restaurants. Kelp will not be traced to individual farms, but farms should be highlighted on the co-op's website to appease socially conscious consumers. If demand is ever projected to be higher than production from members, the co-op could preemptively give seed spools to non-member farmers and buy back kelp at a lower price. This would encourage membership and keep production consistent.

4. Industry development

The large and established co-ops in this study have advanced producer and processing technology and employed individuals and members who lobby and work to move the industry forward in the interests of the members. Influencing policy in Maine will be critical for a kelp co-op to ensure there is continued room for growth. Furthermore, with a changing climate and growing interest in open-ocean aquaculture (Sneed, 2020), climate, biology, and technology research is imperative for staying competitive.

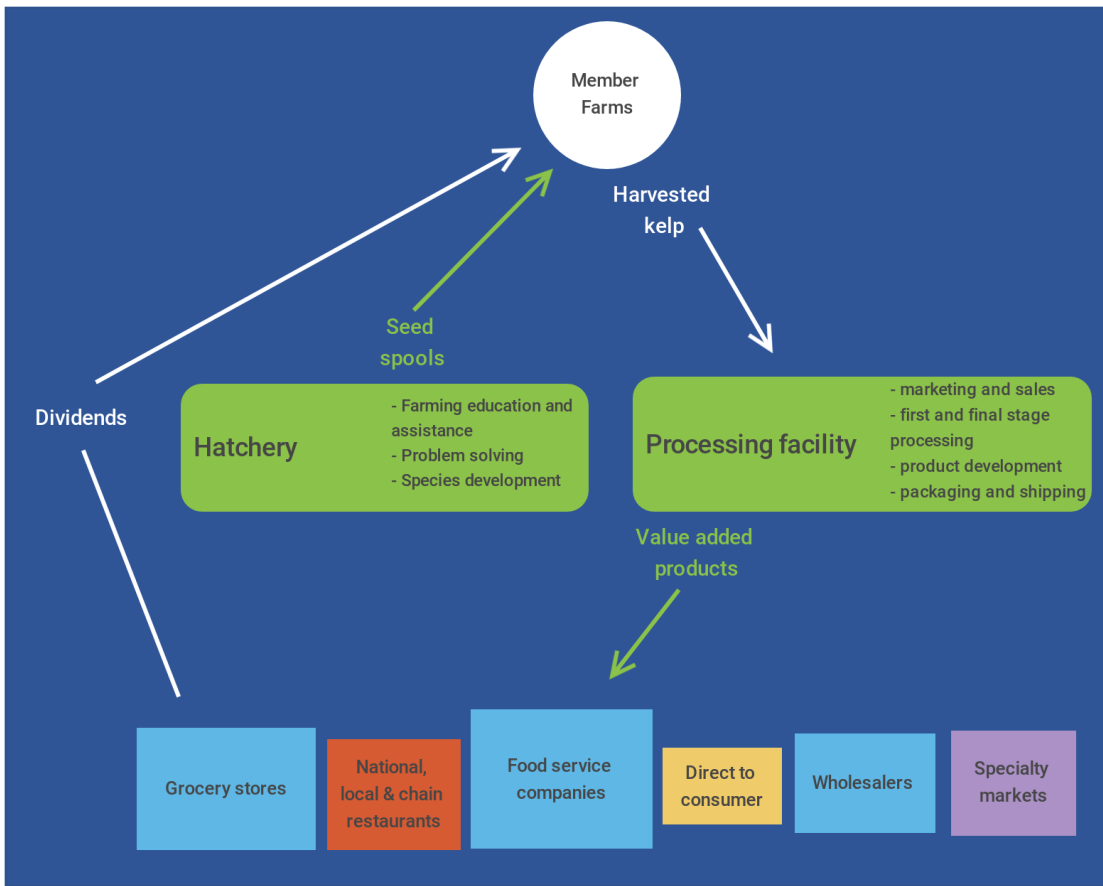


Figure 9 A visual of the proposed recommendations for a hypothetical kelp cooperative

5.3 For all co-ops

1. Do one thing well first

The recommendations for each co-op - MAC and a potential kelp co-op - are attainable but ambitious. Working in steps, as I have outlined, and achieving each one before moving forward, will contribute to its success. Furthermore, establishing a solid plan with explicit goals right off the bat, and communicating the plan to new members will ensure transparency, consensus and capital.

2. Understand the co-op's purpose

The benefits of a co-op are broad and go beyond the financial. While a co-op is a great tool for reaching scale, bargaining on price, saving money through group purchases and shared equipment and personnel, securing grants, and more, the co-op is viewed by many members as a vehicle for selling product while focusing on farming or fishing. Individually, a producer may work the market better and finish some years with more money than a co-op member. The strength of a co-op comes from its consistent security over the long run. A well-run co-op can provide its members a guaranteed buyer, market stability, loans, reduced competition, a unified voice, and a stronger community.

3. Do your research

Before starting a co-op, work with a co-op development agency, educate yourself on different types of co-ops, talk with founders of established co-ops, and create a survey to determine what potential members envision.

4. Kickstart the co-op with capital

Co-op members can bring in funding through annual fees, but slowly building up a co-op without a large initial investment can be tricky and slow. Investing in a co-op that is centered on community growth may be desirable to angel investors because of its ability to positively affect multiple people. Otherwise, securing a loan or a grant through an institute or an organization dedicated to developing working waterfronts or rural communities may be an option. Scraping together small grants over time may be acceptable to acquire “nice to haves” but it is not sustainable. A co-op is a business and needs to be kickstarted.

5. Don't have jerks

To take the advice from the founder of one of the co-ops researched, don't have jerks on your membership. It may seem obvious, but a co-op is unlike any other business model. Cohesion is critical because the agenda is moved forward through voting, not through a chain of command. This can be helped with the producer, probationary and advisory membership advice I provided in the MAC section. When first starting a co-op, make sure everyone agrees with the initial and future goals. Establish camaraderie because the start may be rocky, profits may be minimal, and some people may put in more work than others. Loyalty and trust will go a long way until paychecks can follow.

6.0 Conclusion and additional models

Executed correctly, a co-op will benefit the members, their community, and the industry they operate in. Aquaculture co-ops are an excellent model to help producers achieve scale, market competitively, or simply have more time to farm. However, a co-op is not the only way to move an industry forward. A guild, association, and community-of-practice are three examples of organizations centered around industry development. These are valuable operations for the Maine Aquaculture Co-op to consider as a majority of their current membership are not producers, but they are entirely comprised of individuals invested in the growth of the industry.

Maine Brewers Guild

Guilds are a medieval concept; traditionally a group of merchants, craftsmen and artisans (Merriam-Webster, n.d). However, the Maine Brewers Guild, a nonprofit organization, has a membership of breweries and allies. It moves the craft beer industry forward through public events, promoting breweries, and incentivizing brewery visits through a Beer Trail Challenge. Ninety-nine-point nine percent of all Maine beer is brewed by a member of this guild. Therefore, it is not exclusive or trying to promote certain breweries. It is interested in building up and preserving all Maine breweries (Maine Brewers Guild, n.d).

Maine Aquaculture Association

The Maine Aquaculture Association is a nonprofit trade organization with a membership of aquaculturalists that represents Maine aquaculture at various levels of government. It works to sustainably develop the industry, connect consumers to local seafood and support working waterfronts. It includes shellfish, fin fish and seaweed.

It provides resources for educators and business planning, a local seafood directory, public events, layman aquaculture information and more (Maine Aquaculture Association, n.d).

The Local Catch Network

Local Catch is a community of fishermen and other industry members working together to increase access to local seafood. It is governed by a volunteer executive committee and is described as a community-of-practice (Local Catch Network, n.d). A community-of-practice is an informal group of people, or a network, centered around exchanging knowledge on a specific topic (Li, et al. (2009). Local Catch works to decrease the supply chain between fishermen and consumers. They do this through Community Supported Fisheries (CSFs), selling at farmers markets, connecting fishermen to school cafeterias and arranging dock pick-ups for consumers. They also host an annual seafood summit and maintain a local seafood finder on their website (Local Catch Network, n.d).

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Appendix

Appendix 1

Semi-Structured Interview Questions for Co-op Members

Survey created by: Phoebe Walsh

Question 1

Briefly tell me about the co-op, what it produces, and your role.

Question 2

What benefits or services does the co-op provide you?

Prompt: What did you do before joining the co-op? How are things different now?

Question 3

How did you feel about joining a co-op?

Prompt: What did you know about co-ops before? What motivated you to join?

Question 4

What are some of the challenges of being part of a co-op? And what are some challenges the co-op faces?

Questions 5

What do you see as the future for the co-op? For you as a producer?

Follow up questions if not answered with questions 1-5

How many members are in the co-op?

If any, what is the new membership fee? Annual fee?

When necessary, interviewees were contacted following interviews to clarify answers/discuss answers in further depth.

Appendix 2

MAC member survey

Survey created by: MAC member

Question 1

What has been most valuable about MAC for you and your operation?

Question 2

What role do you see the co-op playing within the next year for you personally? More broadly?

Questions 3

What role do you see the co-op playing within the next year more broadly (i.e., educating consumers about farmed scallops more generally)?

Question 4

What role do you see the co-op playing within the next 5 years for you personally?

Question 5

What role do you see the co-op playing within the next 5 years more broadly (i.e., educating consumers about farmed scallops more generally)?

Question 6

What activities should the co-op continue and/or begin to pursue... (check all that apply)

- Hold regular member meetings to share best practices and trouble shoot
- Apply for grant funding
- Provide marketing support
- Facilitate product sales and distribution
- Help build a brand for Maine farmed scallops
- Secure equipment for members to share
- Facilitate bulk orders for equipment and materials from Japan and elsewhere
- Provide support for filling out lease paperwork
- Recruit additional members
- Play a role in policy development by educating policymakers about scallop farming, fighting bills that do not serve membership, or working with legislators and others to develop appropriate policies
- Other: _____

Appendix 3

Scallop Production Survey

Survey created by: Phoebe Walsh

Question 1

Are you (or the farm you work for) currently selling scallops?

Yes

No

Question 2

Where do you sell your scallops?

Question 3

If you don't currently sell, do you plan to in the next one or two years?

Yes

No

I already sell