

Title: Moving mussels offshore? Perceptions of offshore aquaculture policy and expansion in
New England

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1 **TITLE**

2 Moving mussels offshore? Perceptions of offshore aquaculture policy and expansion in New
3 England

4 **ABSTRACT**

5 Efforts to expand marine aquaculture into offshore environments have increased in the United
6 States, however many questions remain about whether offshore aquaculture is a feasible and
7 appropriate activity. This paper explores these questions by investigating stakeholder perceptions
8 of offshore mussel aquaculture in New England, USA. These views provide insight into the
9 important challenges and opportunities facing expansion, and elucidate whether and how
10 industry may develop and be incorporated into ocean planning and management. Results shows
11 that regulatory and financial conditions are considered the primary challenges facing offshore
12 expansion, whereas technical, environmental, and market conditions were generally deemed
13 favorable or manageable. There is greater uncertainty about social and political conditions.
14 While moving mussel aquaculture offshore lessens the conflicts associated with inshore activity,
15 it also moves industry into new spaces with unfamiliar users. There are tensions inherent in
16 addressing these challenges. Whereas broad regulatory change will encourage offshore
17 development, targeted government involvement may be more productive in the near term.
18 Similarly, while large seafood companies may appear viable candidates for offshore
19 development, they are also limited by regulatory, social, and political resistance. Overall, an
20 increased emphasis on government interventions at the local and regional scale are desirable for
21 proponents of offshore expansion. The paper discusses the management implications of these
22 findings, and suggests that a shift in focus toward targeted and non-regulatory government
23 interventions; local, regional, and informal planning discussions; and community-based and

1 cooperative mussel aquaculture initiatives may hold promise for responsible development in
2 New England offshore waters and elsewhere.

3

4 **KEYWORDS**

5 offshore aquaculture; stakeholder perceptions; mussels; ocean planning; New England

6

1 1. INTRODUCTION

2 Expanding marine aquaculture has been a longstanding stated goal of the US federal
3 government (National Aquaculture Act of 1980; Stickney, 1996), but development has
4 historically been driven primarily by state and industry initiatives. Marine aquaculture in the US
5 is concentrated in protected inshore state waters that are relatively easy to access and farm, and
6 suitable for species such as oysters, clams, mussels, and salmon. Domestic production remains
7 modest, comprising only 1.5% of the US domestic seafood supply (NOAA Fisheries, 2012a),
8 with the vast majority of the nation’s seafood caught or grown abroad (91% in 2011; NOAA
9 Fisheries, 2012b). In an effort to address this disparity and allay concerns over a safe and secure
10 seafood supply, federal and industry support for increased domestic marine aquaculture
11 production has grown dramatically over the past two decades. Joint 2011 policies from the
12 Department of Commerce and National Oceanic and Atmospheric Agency (NOAA) emphasize
13 sustainable growth in the sector (DOC, 2011; NOAA, 2011b), and many proponents of
14 expansion in government, industry, and research communities see offshore waters¹, including the
15 federal waters of the Exclusive Economic Zone (EEZ; 3-200 miles offshore), as the next
16 opportunity for development (e.g., Cheney et al., 2010). However, many questions remain about
17 how to operationalize this interest, and whether offshore aquaculture is a feasible and appropriate
18 activity.²

¹ For the purposes of this paper, “offshore” aquaculture refers to farming beyond the near- and in-shore coastal zone. Both state and federal waters can exhibit offshore (or “open-ocean”) conditions, so although regulatory purview is different in these two spaces, actual production conditions may be the same.

² For general discussions of the national offshore aquaculture debate and its legal, regulatory, environmental, and economic components in the US, see, e.g., Cicin-Sain et al., 2001; Marine Aquaculture Task Force, 2007; Rubino, 2008; Upton and Buck, 2010; Fairbanks, 2015.

1 This paper explores these questions through the case of offshore blue mussel (*Mytilus*
2 *edulis*; ‘mussel’ hereafter) farming in New England, USA.³ With offshore aquaculture pilot
3 projects initiated or completed off New Hampshire, Massachusetts, and Rhode Island to
4 demonstrate viability in both state and federal waters (Hoagland, Kite-Powell, & Jin, 2003;
5 Langan & Horton, 2003), as well as some demonstrated successes overseas (Langan 2013),
6 mussels have been identified as an excellent candidate for expansion and enrolled into the
7 broader push offshore. In this chapter, I examine the perceptions of marine aquaculture
8 stakeholders in New England regarding offshore expansion and whether and how it will take
9 place, focusing on individuals active in industry, research, management, and policy. Identifying
10 stakeholder perceptions and perspectives on the challenges and opportunities for offshore mussel
11 aquaculture provides a window into the on-the-ground realities of development, their links to
12 management and national policy discussions, and the discourses connecting them. This analysis
13 complements structural and theoretical analyses of expansion (e.g., Hoagland et al., 2003; Jin,
14 Kite-Powell, & Hoagland, 2005), providing a nuanced understanding of the perceived social,
15 regulatory, and economic conditions necessary for offshore mussel aquaculture in New England,
16 and domestic marine aquaculture expansion more broadly. By examining an actual case of
17 emerging offshore development, it also provides grounded insights about how marine
18 aquaculture and offshore policy is actually being interpreted and applied in particular spaces,
19 focusing on the overlooked perceptions, actions, and relations of those involved in local or
20 regional development.

21

22 **2. MARINE AQUACULTURE AND THE ROLE OF STAKEHOLDERS**

³ This paper focuses on the New England coastal states of Maine, New Hampshire, Massachusetts, Rhode Island, and Connecticut. Vermont, with no marine coastline, is not included in analysis.

1 Researchers have suggested a number of explanations for the underwhelming
2 performance of the US marine aquaculture sector. Knapp (2012), for example, suggests the
3 industry's small size, its contentious use of public waters, a negative view of aquaculture among
4 the public and the environmental NGO community, and a problematic governance system for
5 leasing and regulation have all hindered domestic production. In terms of offshore development,
6 Rieser and Bunsick (1999, p. 95) point specifically to the "legal and regulatory concerns" of
7 "property rights for aquaculture operators, conflicts with competing uses of public waters, and
8 regulatory gaps and overlap" as constraining financial viability and EEZ development writ large.
9 Others have similarly pointed to legal and conceptual constraints, noting an unclear and limited
10 regulatory framework offshore (Cicin-Sain et al. 2001; Upton and Buck 2010), inconsistent and
11 sometimes inappropriate rules for New England mussel farming in particular (Duff, Getchis, and
12 Hoagland 2003), and conflicts over use, property rights, and environmental and aesthetic
13 impacts, for both (Upton and Buck 2010; Skladany, Clausen, and Belton 2007; Stickney et al.
14 2006).

15 Explicit and implicit in many of the concerns surrounding offshore aquaculture are social
16 and political issues that must be addressed, even if many of the structural and technical barriers
17 to development are overcome. Furthermore, many of these issues may be context-specific,
18 dependent upon the location, species, and the local stakeholders involved in potential
19 development, among other things. Despite this, few studies have explored such social and
20 political considerations, or the challenges and opportunities to offshore aquaculture development
21 in specific contexts. Fewer still have examined particular cases of development or engaged the
22 stakeholders involved. As a result, few data exist on stakeholder perspectives regarding the
23 obstacles described by Knapp (2012) and others, or on offshore development of actually existing

1 and emerging industry in particular places. It is unclear whether on-the-ground conditions reflect
2 the more general explanations often put forth regarding industry growth. This article seeks to
3 address this gap in the literature through its case study approach.

4 Stakeholder perspectives, including perceptions of environmental costs and benefits,
5 social and political conditions for expansion, economic and technical feasibility, and the
6 existence, applicability, and legitimacy of regulations, can all impact whether and how offshore
7 development is debated and progresses. This is especially true given that the industry is small
8 and, as a result, data poor. Perceptions can exacerbate or ameliorate conflicts over ocean space
9 and appropriate use, and more generally serve to “delimit the universe of...political discourse
10 and possible policy options” (Jasanoff and Wynne 1998, p. 5) as certain views gain traction and
11 others are marginalized in planning and development discussions. Recognizing and exploring
12 these stakeholder perceptions is critical to understanding conflict over development, as “the
13 political challenges faced by US marine aquaculture are as important as the technical and
14 economic challenges” (Knapp 2012, p. 53), but their specifics may be poorly understood in
15 context.

16 For offshore mussel aquaculture, the “obstacles to development...are primarily
17 economic, social, and political in nature” (Langan, 2013, p. 1237). However many of the details
18 regarding these broad obstacles are unclear. General policy goals at the federal and state levels,
19 such as the NOAA and Commerce statements, only go so far to enable and motivate sustainable
20 offshore aquaculture development. The perspectives of stakeholders, and how those views are
21 presented and argued in social and political forums, can have real impacts on development
22 outcomes. They can forge alliances between likeminded actors, influence how different actors
23 engage in management, and reshape the policy landscape in the process—to the benefit or

1 detriment of particular goals and development outcomes (Dryzek, 2005; Roe, 1994). Chu et al.
2 (2006, p. 74), for instance, show that in the US and Norway, aquaculture stakeholders'
3 perceptions "can significantly affect their decisions regarding whether or not to actively support
4 aquaculture expansion," while McGinnis and Collins (2013) demonstrate that epistemological
5 differences between stakeholders have exacerbated conflict over aquaculture planning in New
6 Zealand. Drawing on a case of proposed offshore farming in California, Tiller et al. (2013)
7 emphasize the importance of understanding stakeholders' perspectives on future offshore
8 development scenarios to better guide planning. More generally, the value of including
9 stakeholders in management is well documented in the ocean planning literature, and continues
10 to be a significant consideration for practitioners (e.g., Gopnik et al., 2012; Pomeroy & Douvere,
11 2008). Ritchie and Ellis (2010) argue that we need to go beyond simply identifying and
12 categorizing marine stakeholders in planning processes by "delving deeper" (p. 717) into their
13 perspectives and how they frame oceans problems.

14 Despite these observations and a growing interest in offshore aquaculture expansion in
15 the US, little attention has been paid to how stakeholders themselves perceive the potential for
16 offshore aquaculture in New England or other contexts (but see Tango-Lowy & Robertson, 2002;
17 cf. Chu et al., 2010; Mazur & Curtis, 2006). This includes a lack of attention to both how
18 stakeholders discuss offshore aquaculture in regards to development and planning processes, as
19 well as their broader perspectives on the social and political conditions for expansion. In New
20 England, stakeholders include members of the industry, research, government, and NGO
21 communities, as well as coastal residents and other ocean users, reflecting a trend toward
22 increasingly open forums for environmental decision-making inclusive of diverse non-
23 government actors (Hajer, 2003). Indeed, independent and joint ventures led by industry,

1 research, and government actors have been responsible for pushing offshore mussel operations
2 forward to date through pilot projects (Barnaby, 2006; Hoagland et al., 2003; Showalter Otts,
3 2012; SSU, 2013). While these activities are motivated by stakeholders' perspectives and
4 interests, they also inform and reshape those views as they communicate the (in)feasibility of
5 offshore development both within and outside the aquaculture community. Such activities can
6 serve to mobilize arguments and coalitions to support (or oppose) larger development efforts (cf.
7 Hajer, 2006).

8 As New England oceans governance moves toward increased participation that seeks to
9 directly engage aquaculturists and others (through, e.g., marine spatial planning (MSP);
10 Lapointe, 2013; National Ocean Council, 2013), understanding the perspectives of aquaculture
11 stakeholders is a useful task. They will influence whether mussel farming emerges offshore and
12 to what extent, defining the possibilities for sustainable development of industry in a multi-use
13 offshore space. This paper, then, seeks to contribute to our understanding of stakeholder
14 involvement in ocean planning and development, provide empirical insights into the many broad
15 pragmatic concerns about offshore aquaculture development in the US, and investigate the
16 specific opportunities and barriers to expansion identified by stakeholders in an emerging case of
17 offshore development in New England.

18

19 **3. METHODS**

20 Between the fall of 2012 and spring of 2013, I conducted 65 in-depth, semi-structured
21 interviews with 67 individuals involved in the US marine aquaculture sector, 41 of which are
22 directly involved with New England. Each interview was approximately one hour long and most
23 were conducted in-person with a single informant, often at that informant's workplace (e.g.,

1 office, farm, etc.); ten interviews were conducted over the phone. Five interviews involved more
2 than one participant, with three informants taking part in two different interviews.

3 Interviewees are categorized into two groups of informants, ocean users and policy
4 actors. Ocean users are comprised of fish and shellfish farmers, seafood industry members, and
5 researchers directly engaged in industry development and marine aquaculture operations
6 (labelled O1-O23). Policy actors include state and federal employees, NGO actors, and
7 researchers involved in formulating, informing, and implementing marine aquaculture policies
8 and regulations (labelled P1-P44). These categories are neither clear-cut nor uniform as some
9 informants periodically (or simultaneously) engage in both roles; however, they represent
10 informants' primary activities and provide a useful rubric for identifying those more involved in
11 policy and regulatory issues or on-the-ground aquaculture development. The 41 individuals
12 directly involved in New England marine aquaculture policy, research, and industry (O1-O21;
13 P1-P20) provide the primary data for this paper, while the remaining informants provide
14 contextual and complementary information about offshore aquaculture issues in the US (O21-
15 O23; P21-P44). Informants were identified through purposive and snowball sampling. Certain
16 informants were targeted due to their roles in aquaculture policy, research, and industry, while
17 others were identified through referrals.

18 Informants were asked a variety of questions related to marine aquaculture in the United
19 States. Semi-structured interview questions followed five general themes: informant
20 demographics and history with aquaculture; issues of space, use, and conflict in the ocean; views
21 on aquaculture policy and regulation; views on the aquaculture industry and science; and
22 perspectives on the future of offshore aquaculture. Within these categories, and in relation to this
23 article, I followed lines of questions related to the feasibility of offshore expansion, using the

1 semi-structured nature of the interviews to modify questioning as appropriate and relevant to
2 particular informants (e.g., more or more detailed questions on political issues or regulation for
3 government informants; technical and scientific questions for researchers; financial, technical,
4 and social questions for operators; etc.). Informants involved in actual offshore mussel
5 operations were also asked to recount their specific experiences with policy, planning, and
6 development, and those directly involved in New England aquaculture were questioned more
7 specifically about conditions and development in the region.

8 All interviews except five were audio recorded and transcribed verbatim. Transcripts
9 were analyzed using the assistance of QSR International's NVivo 10 qualitative analysis
10 software to identify and code for key themes and discourses in participants' responses. The data
11 were analyzed with both deductive and inductive coding. For example, deductive coding schema
12 were created for important topics found in the literature, such as regulatory and technical
13 feasibility, while inductive coding focused on themes, trends, and other patterns that emerged
14 during analysis, such as an interest in cooperative and community-oriented (offshore)
15 aquaculture projects. Overall, I conducted qualitative analysis of the interviews by using existing
16 and "emergent categories...to organize and group codes into meaningful clusters" (Hsieh and
17 Shannon 2005: 1279), and to identify key concerns, tropes, and discourses common among
18 respondents (Fairclough 2003; Roe 1994). Interview data were complemented by document
19 analysis of government and research reports, and participant observation at aquaculture
20 conferences and meetings. Combined, these methods help elucidate how science, policy, and
21 perspectives about offshore aquaculture—and mussel aquaculture specifically—circulate among
22 stakeholders and may influence planning and development.

23

1 **4. RESULTS**

2 **4.1. Opportunities for offshore mussel aquaculture**

3 While New England mussel and other shellfish farming has traditionally taken place in
4 inshore coastal waters, in this section I describe the perceived opportunities for offshore mussel
5 aquaculture as identified by informants. Informants were optimistic about three components of
6 offshore aquaculture: (1) technical considerations, (2) environmental conditions, and (3) market
7 opportunities.

9 ***4.1.1. Technical considerations***

10 While mussels are grown in New England with a variety of gears (Morse & Rice, 2010),
11 offshore sites have found the most success with submerged longline systems. This technology,
12 used in New Zealand, Japan, and elsewhere, “support[s] high capacity and high efficiency”
13 (Morse and Rice 2010, p. 2) allowing operators to take advantage of offshore conditions, such as
14 space for economies of scale and beneficial water quality for growth (Cheney et al. 2010; Langan
15 2013). Both “the biological and engineering feasibilities of this new kind of technology” have
16 been demonstrated in regional pilot projects (Hoagland, Kite-Powell, and Jin 2003, p. 11), and
17 all offshore mussel operations in New England are using this technology.

19 ***4.1.2. Environmental conditions***

20 Informants agreed that environmental conditions are viable for offshore mussel expansion
21 in New England, with some caveats. Some expressed concerns about interactions with pest
22 species, but none felt these would be prohibitive (see also Morse & Rice, 2010). In the case of
23 pea crabs and sea squirts that can infest or foul mussels, for instance, offshore currents are

1 believed to be more conducive to dispersing pest larvae away from farm sites (whereas semi-
2 enclosed inshore sites run a greater risk of larval settlement), and care can be taken to avoid
3 transporting them to sites via boat (e.g., O4, O6, P5). While extreme weather events are a
4 concern, informants noted that most problematic wave and weather conditions could be
5 addressed through appropriate siting and gear, and they were confident in the dependability of
6 submerged longline designs (see also Langan and Horton 2003; Langan 2013).

7 Informants expressed various levels of concern about possible interactions with protected
8 species. Some expressed concerns about potential as well as perceived interactions, as protected
9 species laws play an important role in aquaculture permitting and operations. However, many
10 informants felt the potential for actual marine mammal or sea turtle entanglements would be
11 minimal and/or manageable, primarily due to the gears' use of vertical lines under tension. These
12 systems pose smaller threats to protected species—particularly whales—than do gears reliant on
13 slack lines or bottom lines, although the density and number of lines must be monitored if the
14 mussel industry expands (P4, P11, P39, P40; see also Moore and Wieting 1999). Existing
15 offshore shellfish projects in the US have reported few to no significant interactions with
16 protected species (Cheney et al. 2010; Ward, Grizzle, and Irish 2006).

17 Overall, most informants felt that environmental concerns could be overcome with
18 appropriate siting and gear, and agreed that offshore environmental conditions were amenable to
19 further mussel development and “not the issue” holding back expansion (P4). Some conditions
20 were perceived to contribute positively to mussel production, by, for instance, offering improved
21 water quality, growth rates, and meat quality in the mussels themselves (O6, O8, O21). One
22 informant mentioned offshore mussel growth and meat quality was “phenomenal” in their
23 experience, echoing Cheney et al.’s (2010, p. 66) broader observation that “[e]xisting offshore

1 farms in the United States and New Zealand have shown growth rates, meat yields, and
2 production rates comparable with the better inshore farms in the same regions.” Pilot projects in
3 New England have shown offshore mussels can achieve marketable size quicker than inshore
4 product (Langan and Horton, 2003) and reach meat yields desirable for the live market (Lindell,
5 2013), suggesting offshore food availability (phytoplankton) is not a limiting production factor
6 given other conditions (temperature, salinity, etc.). In turn, mussel operations may offer their
7 own environmental benefits, such as water filtration and shelter for fish species, according to
8 some informants (O6, O13, O19, P19). Regardless, seasonal changes and other periodic offshore
9 concerns, such as harmful offshore algal blooms, must be monitored to ensure successful and
10 safe production.

11

12 ***4.1.3. Market opportunities***

13 Informants considered the market conditions for offshore mussel aquaculture conducive
14 to development. One industry informant relayed their experience selling product:

15 People went crazy. The restaurants we sold them to, the distributors we sold them to. We
16 sent a bunch to [a seafood distributor], and they said, “I can’t sell these.” And I said,
17 “What do you mean you can’t sell them?” And they said, “They’re too good. If I send
18 these to my customers, they’re gonna want them all the time and they’re gonna think the
19 things I sent them before and after are crap. [...] So unless I can get a steady supply of
20 these, I can’t sell them.” (O8)

21

22 This sentiment was reflected by the majority of informants, who felt that market demand was
23 ripe for increased domestic mussel production. In particular, many believed that the quality of
24 New England offshore mussels was (or would be) significantly higher than imported product and
25 could rapidly displace live Canadian mussels and even some frozen imports (from, e.g., New
26 Zealand or Chile) in local and domestic seafood markets. “The price point is there” (O2), one
27 informant involved in seafood distribution succinctly noted, while others echoed that there is a

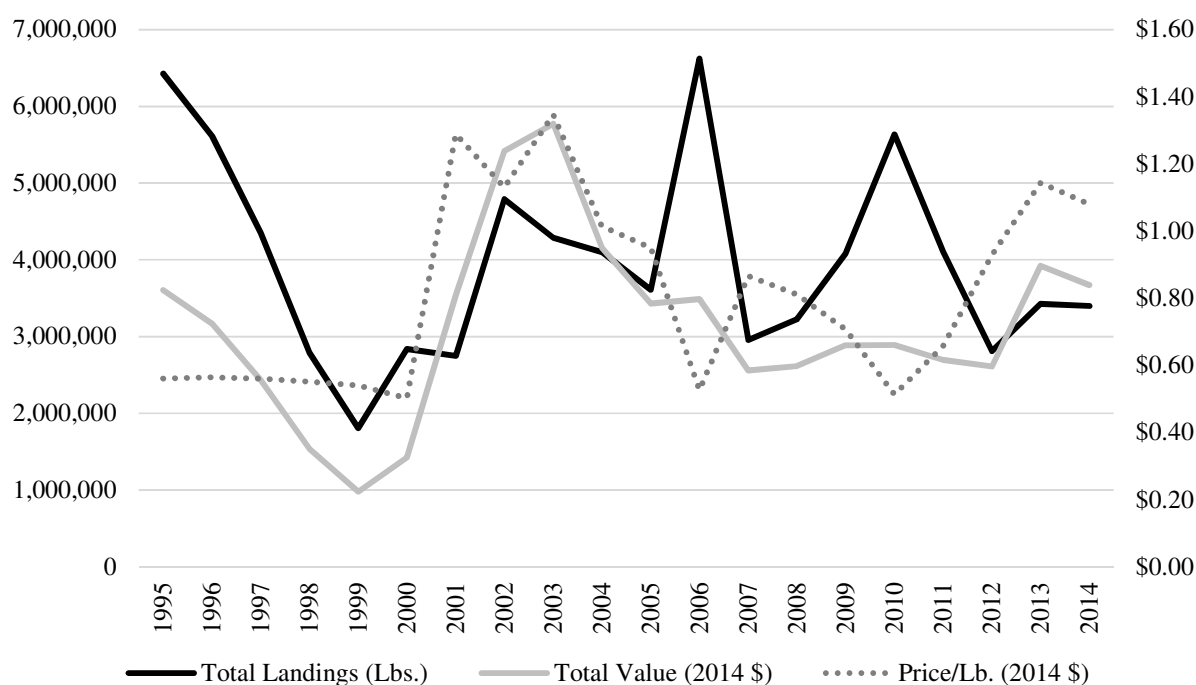
1 “huge opportunity” (O21) and a “big,” “growing market” (O1) for exactly the type of product
2 offered by offshore mussel farms.

3 Data on US and state-by-state aquaculture production and the market for blue mussels are
4 inconsistent over time and spotty in geographic coverage. The USDA’s National Census of
5 Aquaculture, for instance, has been updated only twice (2005, 2013) and includes few data on
6 shellfish aquaculture production in New England. NOAA’s commercial landing statistics for
7 mussels includes aquaculture production, however aquaculture harvest (and landings by other
8 gears) are inconsistently specified or not identified at all, making it difficult to determine
9 aquaculture’s contribution to total landings. At the state level, aquaculture production statistics
10 for New England are incomplete. In some cases, mussel production data exist for select years,
11 but overall, data are often unavailable or unspecified due to incomplete reporting or
12 confidentiality requirements (i.e., production and revenue for individual farms are not reported,
13 and therefore may remain aggregated with mussel production/landings by all other gears).

14 However, despite these data limitations, there is some evidence of recent growth in New
15 England farmed shellfish production that may give credence to informants’ assertions of a ready
16 (or growing) market for farmed mussels. The Massachusetts shellfish farming industry, for
17 example, produced \$11 million of product in 2006, and both production value and the number of
18 farmers participating in the sector have climbed since (Reitsma et al., 2012). Rhode Island
19 successfully revised its shellfish aquaculture laws in 1996 to facilitate industry growth,
20 increasing total harvested shellfish value from less than \$100,000 per year prior to over \$4
21 million now (CRMC, 2014; Rice, 2008). Mussel production has increased from 3000 pounds in
22 2011 to over 15,000 pounds in 2014, and new mussel farms have recently been permitted by the
23 state (CRMC, 2014). Maine has seen consistent mussel production over the past decade, with

1 total farmed value for the species averaging nearly \$1 million annually from 2005-2012 (Maine
 2 DMR, 2014). Overall, according to NOAA, New England mussel harvest (farmed and wild) has
 3 averaged approximately four million pounds annually between 1995 and 2014. Total landings,
 4 total value, price per pound have fluctuated over this time, sometimes substantially. However, in
 5 2013 both total value and price per pound reached their highest levels in nearly a decade, with
 6 similar levels in 2014 (see Figure 1).

7



8

9 **Figure 1.** Commercial blue mussel landings, value, and price per pound in New England (wild and
 10 farmed), 1995-2014. (Source: NOAA Fisheries, 2014)

11

12 4.2. Challenges for offshore mussel aquaculture

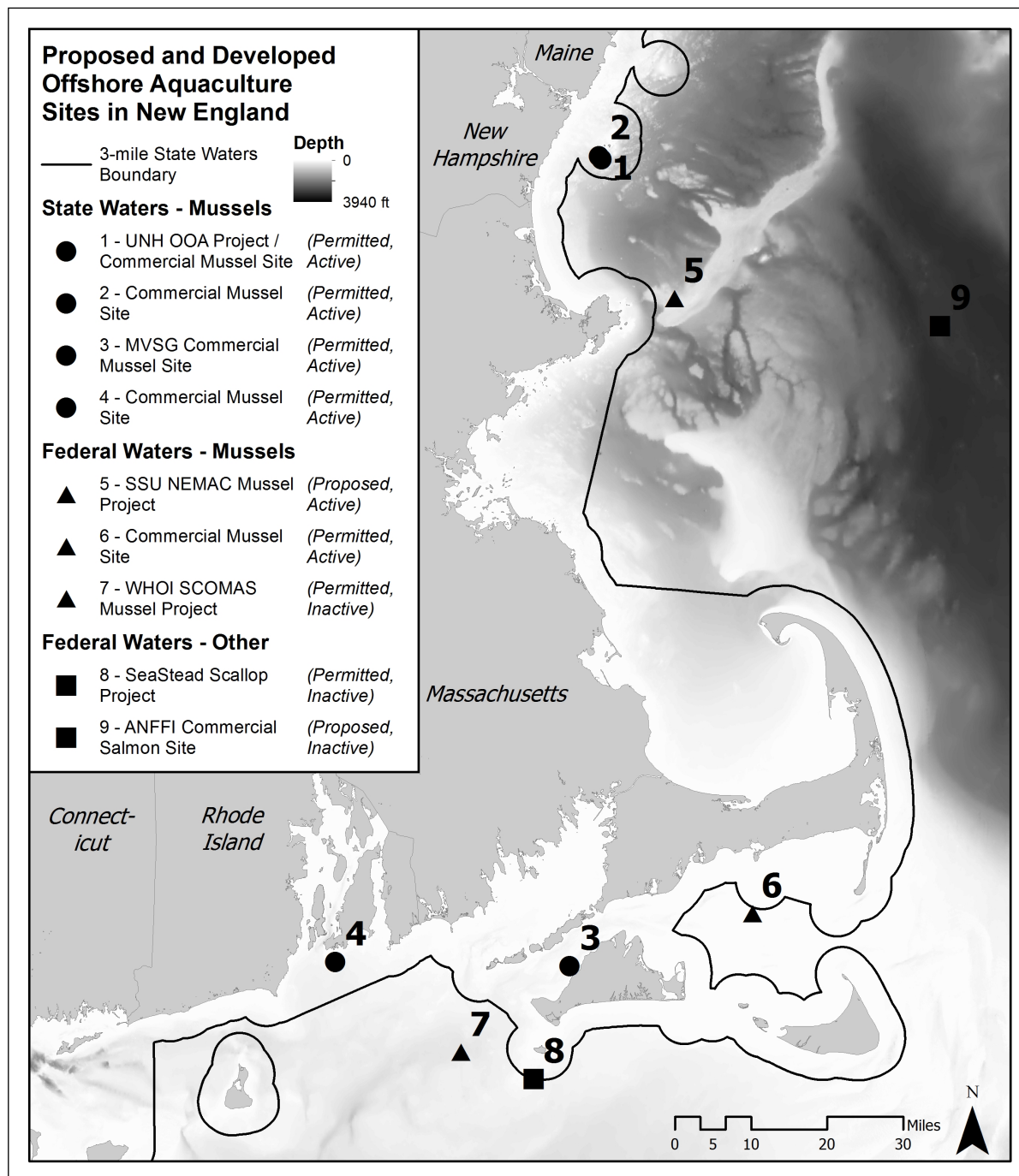
13 Despite the mussel farming successes noted by informants, and their (and other
 14 stakeholders') optimism about many of the environmental, technical, and market factors
 15 influencing development, large-scale offshore mussel operations do not exist in the US. So far,

1 only pilot sites, small commercial plots, and research-oriented operations exist. Other attempts at
2 offshore aquaculture in New England, including a proposed salmon farm and a scallop project,
3 have similarly been met with limited success (Figure 2). Why is this so, and what factors do
4 stakeholders believe are affecting offshore mussel aquaculture New England? In this section, I
5 explore these questions by focusing the three key issues raised by informants: (1) regulatory
6 concerns, (2) financial costs, and (3) linked social and political issues.

7

8 ***4.2.1. Regulatory concerns***

9 The regulatory framework for offshore mussel aquaculture is composed of diverse state
10 rules for adjacent waters and a variety of federal mandates in the EEZ. New England coastal
11 states each feature their own regulatory systems for aquaculture within state waters, however
12 they all generally seek to centralize application and permitting processes in single lead agencies
13 or offices (though coordination is required across state offices and separate permits may still
14 need to be sought by applicants; e.g., from the Army Corps of Engineers). Massachusetts
15 delegates shellfish authority to its towns, pursuant to state rules. The states all have mature
16 regulatory frameworks that have contributed to some mussel (and other shellfish) production
17 increases over recent years, and each provides a measure of private tenure rights to aquaculture
18 operators on their leased farm sites.



1
2
3 **Figure 2.** Past and present offshore aquaculture sites in New England, as of 2015. In state waters, 7
4 operations have been permitted for offshore mussel farming. Site 1 has been the subject of 4 permits, first
5 for the UNH Open-Ocean Aquaculture Project and later 3 commercial operations. In the EEZ, 1 offshore
6 mussel operation has been conducted, a second has recently been permitted, and a third is in the permit
7 process. While not mussel operations, Sites 8 and 9 are notable as they are the only other offshore
8 aquaculture attempts in New England (Site 9 location is estimate). *Permitted* sites have received the
9 necessary permits and are/were operational. *Proposed* sites are/were in the permitting process. *Active* sites
10 are currently in the respective processes of permitting or operation. *Inactive* sites have ceased the

1 permitting process and/or operation. (Sources: Lapointe, 2013; Lindell, 2013; Martha's Vineyard
2 Shellfish Group; NEFMC 1998; New Hampshire Fish and Game Department; Salem State University;
3 University of New Hampshire; US Army Corps of Engineers; Woods Hole Oceanographic Institute)
4
5

6 Generally speaking, these state-level frameworks have been designed and tailored for
7 inshore spaces where aquaculture has historically occurred. Therefore, though state regulations
8 extend into offshore waters, they may be inappropriate for those spaces. Their usefulness can
9 vary dramatically by the location, size, and type of offshore aquaculture in question. While
10 projects in offshore New Hampshire and Rhode Island waters saw few setbacks during
11 permitting, projects in Massachusetts waters have presented significant challenges for applicants.
12 One pilot project off Martha's Vineyard (MA), for instance, required nearly two years and an
13 estimated \$30,000 in expenses before a permit was issued—a process significantly more
14 complex and costly than most inshore leases (Karney et al., 2010). Proponents were required to
15 engage a variety of unexpected and unfamiliar regulatory agencies and other organizations, and
16 carry out costly site analyses.

17 In some ways, this Massachusetts experience mirrors conditions in federal waters beyond
18 three miles. There is no single overarching law dedicated to governing offshore aquaculture in
19 the US. Instead, the legal and regulatory framework for the EEZ is characterized by piecemeal
20 laws, regulations, and agency responsibilities (Cicin-Sain et al., 2001). While NOAA has
21 claimed primary jurisdiction over many private and public activities related to oceans spaces and
22 living resources, it alone cannot permit or lease ocean space for offshore aquaculture in the EEZ.
23 It lacks the ability to provide the type of tenure rights to offshore applicants that are otherwise
24 available within state waters. Past offshore aquaculture attempts in New England, including a
25 proposed large salmon farm (American Norwegian Fish Farms, Inc.; late 1980s-1990s) and a
26 scallop enhancement and aquaculture operation (SeaStead Project; late 1990s), contributed to

1 NOAA reassessing its policy and regulatory roles for offshore aquaculture, however its authority
2 over the activity was not fully consolidated or clarified. At least nine federal agencies and a
3 variety of statutes play important roles in regulating aquaculture in the EEZ (Cicin-Sain et al.,
4 2005), while dozens of others have direct or indirect involvement (DeVoe, 2000; Duff et al.,
5 2003; Aspen Corp., 1981). Many gaps and overlaps in authority exist between them. In addition
6 to NOAA, the Army Corps of Engineers (Army Corps) and the Environmental Protection
7 Agency (EPA) are often regarded as the lead federal agencies for administering offshore
8 aquaculture in federal waters (Rieser and Bunsick 1999; Showalter 2009), while the Department
9 of Agriculture (USDA) provides non-regulatory support to the aquaculture sector more generally
10 (e.g., research funding, financing).

11 Prospective offshore operations need permits from the Army Corps for the use of gear
12 and ocean space under the Rivers and Harbors Act, and for the appropriate use of waters under
13 Section 404 of the Clean Water Act (in coordination with the EPA) (Showalter Otts 2012). Army
14 Corps permits may require consultations with other agencies and their regional offices, including
15 NOAA for guidance on potential site interactions with the Endangered Species Act, the Marine
16 Mammal Protection Act, and the Magnuson-Stevens Fisheries Conservation and Management
17 Act. More generally, consultations may be required under the National Environmental Policy Act
18 (NEPA), which requires agencies to consider the environmental impacts of their decisions and
19 activities. Depending on the type (e.g., shellfish or finfish) and scale (e.g., small-scale or large
20 corporate venture) NEPA may require environmental assessments (EA) or environmental impact
21 statements (EIS) for prospective operations. Together, these laws guide NOAA, the Army Corps,
22 the EPA, and other agencies (e.g., Fish and Wildlife Service) to determine impacts on protected
23 species, marine mammals, essential fish habitats, or other sensitive areas. The Food and Drug

1 Administration (FDA) oversees aquacultured product as it is processed and brought to market to
2 ensure its safety and proper handling through the production and supply chain.

3 The Clean Water Act can necessitate direct involvement of the EPA for offshore
4 aquaculture permitting, including permits for discharges (Section 402 of the CWA: the National
5 Pollution Discharge Elimination System program; NPDES). However, this involvement is
6 unclear (HLS EELPC, ELI, and The Ocean Foundation 2012), and depends on the type and scale
7 of operation as well as how its offshore structures are legally defined. However, most shellfish
8 operations, including mussel farms, require little direct interaction with the EPA or additional
9 permits as they involve few to no inputs and outputs (Showalter, 2009). Moreover, because
10 shellfish farms generally do not involve dredging, significant bottom disturbance, food inputs,
11 and produce few discharges, they do not require a full EIS (Showalter Otts, 2012). In contrast,
12 offshore finfish operations need to carry out an EIS and seek permitting from the EPA because
13 they involve inputs and outputs such as feed and fish waste, and can have impacts on
14 surrounding water quality, fish populations, and environments.

15 In federal waters, permitting and consultations with state and local agencies are also often
16 necessary under the auspices of the Coastal Zone Management Act (CZMA) and local laws. The
17 CZMA requires any federal ocean activities to be consistent with adjacent state coastal policies if
18 the activities are expected to impact state waters or coastal zones. Offshore aquaculture may
19 meet these standards, as escaped fish, for instance, could swim into state waters. Even in the case
20 of mussel aquaculture, products and gear are transported through state jurisdictions. This process
21 is further complicated as state coastal policies can vary, and determining consistency may require
22 substantial coordination if projects lie offshore multiple states (as is possible in New England
23 waters).

1 In short, the process *on paper* for permitting offshore mussel aquaculture appears
2 relatively straightforward: it begins with the Army Corps and is then channeled through relevant
3 state and federal agencies to ensure consistency and to secure secondary permits and
4 consultations. Moreover, it bypasses some of the complications that arise for finfish due (e.g.,
5 extensive EPA involvement). However, *in practice* the majority of research informants were
6 dissatisfied and often uncertain about the federal regulatory framework (e.g., O16, O19, P13).
7 One informant explained their understanding of the permitting process:

8 There's a process [where] you start with the Army Corps, typically, and other agencies
9 get involved depending on the species that you plan to grow. But it is cumbersome, it's
10 not clear, and it's still ad-hoc in a lot of ways. There's certainly no one-stop office to go
11 to that then coordinates everything for you. There's no federal guidance on which areas
12 the federal government considers to be preferred places to do this sort of work in.
13 Nothing like that. (P15)

14
15 Many informants were unaware of the steps necessary to secure permitted space in the
16 EEZ—including some directly involved in past and existing projects. The sharing of regulatory
17 authority across federal and state agencies (and offices within agencies) can also cause
18 miscommunications and a lack of coordination between them and with applicants, resulting in a
19 drawn-out and costly process. One industry member stated that you “have to basically hire
20 somebody else to do” (O6) the permitting work because it is so complicated, particularly as
21 permitting issues and regulatory actors can seem to come “out from left field” (P15) throughout.
22 Further, because many agency employees are unfamiliar with offshore aquaculture and what it
23 entails, permitting processes can often result in confusion and inaction among parties.

24 According to informants, agency unfamiliarity with aquaculture can also lead some
25 regulators to strictly apply the precautionary principle and thus stifle development (e.g., O4, O7,
26 O13, P7, P17, P19). In this view, rather than seeking “compromise” to balance environmental
27 concerns with the realities of commercial development (O4), these regulators too quickly fall

1 back on guidance legislation that is often focused on specific aspects of resource protection:
2 “[T]heir job is to look out for that resource, for whatever resources they’re supposed to look out
3 for. But with no common sense. There’s no bigger picture thing that’s envisioned” (O4; also,
4 e.g., P8). For example, even if actual protected species interactions may be minimal or
5 nonexistent, some informants were concerned that perceived risks and linked regulatory action
6 could slow development processes, particularly as offshore New England waters are used by
7 animals such as endangered North Atlantic right whales (*Eubalaena glacialis*). One offshore
8 project currently in permitting processes has been delayed by protected species issues.

9 While offshore aquaculture is officially encouraged by federal policy, lack of authorizing
10 and enabling federal regulation puts the activity in the hands of myriad other laws that may not
11 be compatible with development. Recent efforts by NOAA have tried to clarify these issues as
12 the agency has sought to assert authority over offshore aquaculture (Fairbanks, 2015), however it
13 still lacks the ability to singularly permit operations.⁴ As some proponents pointed out, this
14 differs substantially from another emerging offshore use, wind energy, which has had siting and
15 leasing streamlined and consolidated under the authority of a single federal agency (Bureau of
16 Ocean Energy Management) to facilitate industry growth. As a result, the dual federal
17 Aquaculture Policies are seen by many informants as encouraging but somewhat empty
18 statements backed by little tangible action to operationalize development, such as streamlined
19 permitting, increased financial support, or clarified regulations (e.g., O3, O4, O15, P8). Further,
20 because the onus for proving the environmental suitability of permitted sites is on applicants,

⁴ NOAA and the Gulf of Mexico Regional Fishery Management council have recently enacted a fishery management plan and related rules for offshore aquaculture in the Gulf. This is a first of its kind approach to offshore aquaculture regulation, however it applies only to federally managed fisheries. Blue mussels are not a federally managed fishery, so this regulatory path is not available for the New England mussel sector.

1 satisfying regulators' (and often other stakeholders') environmental concerns can be an
2 exceptionally onerous and costly process (O7).

3

4 **4.2.2. Financial costs**

5 Uncertain and costly regulatory conditions directly contribute to an already risky
6 investment environment for offshore mussel aquaculture (e.g., O6, O17, P6, P14, P30). With the
7 current regulatory framework often considered equivalent to none at all,

8 ...even corporations don't want to invest money because they're saying, 'Where's the
9 regulations?' There's no regulations in place—that's the problem. And that's what scares
10 everybody. (O11)

11
12 Financial feasibility studies suggest that initial capital costs for a large-scale offshore
13 commercial mussel farm in the US (approximately 120 longlines) are likely in excess of \$1
14 million, with lifetime costs potentially reaching 4 times that amount (Hoagland et al., 2003;
15 Kirkley, 2008). In their sample business plan and analysis, Hoagland et al. (2003) note that at
16 this farm size, full production on all longlines could begin in the third year of operation and
17 profitability could be reached in 5 to 7 years depending on the price of mussels. These estimates
18 include costs of gear, expendable supplies, vessel acquisition and maintenance, personnel, and
19 onshore infrastructure (Hoagland et al., 2003, p. 16). In comparison to these analyses, over the
20 course of the present research informants' perceptions about finances varied. They estimated that
21 successful offshore mussel operations could cost anywhere from \$100,000 to \$9 million (e.g.,
22 O8, O9, O12), with some suggesting a new vessel was not always necessary—lowering costs by
23 using a used or modified fishing vessel rather than constructing a new one. Regardless, all
24 informants were aware of investment and development challenges, even when taking into
25 account a perceived ready market for local product. There was agreement that combined with

1 regulatory uncertainty, financial costs were inhibiting offshore mussel expansion. Some worried
2 that offshore aquaculture is simply not “economically viable” (O3) in the US and that interested
3 investors and companies will move to develop in more accommodating countries (as has already
4 been seen with some offshore finfish operations). High financial costs also explain why many
5 past and existing projects are affiliated with universities and research laboratories who have the
6 resources to risk such an endeavor, rather than commercial investors and entrepreneurs (O8,
7 P16).

8 For many proponents of offshore aquaculture, the most important aspect of financial risk
9 relates to tenure rights for offshore space. Unlike in state waters, where some tenure rights can be
10 secured through leases, permits offered in federal waters do not supply the same security. Under
11 current regulations only 5-year renewable permits are available from the Army Corps for
12 offshore EEZ aquaculture projects. This permit system is “clearly inappropriate” (P13) for
13 offshore development, as described by one government informant:

14 I’ve been asking this question since I’ve been in this job: “Who’s in charge?” And I hear
15 NOAA say “Oh, we’re in charge.” OK. And my response is, “Can you lease? Can you
16 give someone a lease?” And they can’t. And the recent answer is: “Army Corps of
17 Engineers is in charge because they have to say, ‘You can put that gear in the water.’”
18 Can Army Corps give someone a lease? And the answer is no! So my question remains:
19 how can you develop offshore aquaculture if you can’t control the area in which you’re
20 growing your animals? And until that’s resolved, it’s going nowhere. (P4)

21 Without the exclusive spatial rights or privileges a lease guarantees, the current system of
22 permits cannot be leveraged to secure bank loans (O13, P18). When combined with a perceived
23 lack of financial support from government sources to fund actual commercial operations,
24 offshore aquaculture proponents and investors have difficulty securing the capital necessary for
25 large-scale investment in mussel farms. These difficulties are particularly prohibitive for existing
26 small-scale aquaculturists and commercial fishermen interested in expanding or supplementing
27

1 their production. One informant mentioned the struggles of a fisherman interested in aquaculture,
2 noting that the high costs and “regulations [are] essentially wiping these guys out.” They
3 continued:

4 The only people [who can do offshore aquaculture] is a huge corporation that will come
5 in and have the financial resources and the time to go ahead and put this kind of permit
6 application in. You’re pretty much wiping the small guys out” (O4).

7
8 Consequently, informants outline a development impasse where: (1) large companies
9 may possess the resources to undertake offshore expansion, but refuse to take on the regulatory
10 and financial risk; and (2) some small-scale producers are interested in offshore operations, but
11 lack the time and resources to successfully move forward. This is further underlain by social and
12 ideological questions regarding who among these actors *should* be involved offshore—large
13 corporations, smaller producers, or some ideal range of diverse operations—and directly
14 contributes to the broader stalemate regarding offshore aquaculture in the US. Negotiating these
15 tensions will be critical to advancing actual development, and requires understanding and
16 addressing the immediate social and political conditions impacting sustainable development of
17 the industry.

18

19 ***4.2.3. Social and political issues***

20 Particularly for inshore waters, coastal landowners concerned with spatial,
21 environmental, and aesthetic impacts often make aquaculture expansion untenable (Kite-
22 Powell et al., 2013). This was noted by research informants in New England. Discussing an
23 ongoing inshore aquaculture lease application, one informant explained that landowners “are just
24 fighting [against shellfish aquaculture] tooth and nail [...] There’s people that just don’t want it
25 in their viewshed and they will never want it in their viewshed” (P2). Another suggested that

1 while any “rational person” would support expanded shellfish aquaculture and the benefits it
2 brings in the abstract (e.g., increased local seafood production), “[i]t’s when you put it in front of
3 their house that they get upset” (O7). More generally, there is a belief that these local attitudes
4 can combine with a broader anti-aquaculture discourse present in the environmental community
5 to severely limit inshore development throughout the nation (O1, O3, O13, P4; see also Knapp
6 2012).

7 Offshore aquaculture is often framed as an opportunity to escape these conflicts. To some
8 proponents, moving “out of sight and out of mind” (O16) of coastal landowners and other
9 inshore users provides an excellent opportunity for large-scale expansion, food production, and
10 economic activity, while also moving any environmental impacts offshore (O17, P8; see also,
11 e.g., Cicin-Sain et al., 2005). One informant explained that “[t]he further away you get the better
12 off you are in [regards to aesthetic conflict]. For mussels, open ocean is the key” (O6).

13 Offshore mussel development, therefore, ostensibly provides an escape from the
14 resistance and entrenched attitudes of coastal residents. Instead, “[b]y going offshore [with
15 mussel aquaculture] we access the different mindset and different groups of allies to focus in on
16 what’s needed to make it happen” (O9). However, even with more space and different social and
17 political conditions, some concern remains about these new “allies” and exactly how “open”
18 offshore space actually is. Many existing conflicts may be alleviated by moving offshore, but
19 others may be exacerbated and new conflicts can arise. Informants noted struggles with
20 fishermen and environmental groups as the primary concerns for expansion, groups “who rightly
21 or wrongly see aquaculture as some sort of negative. [...] That has been a big stumbling block
22 today, in fact, in offshore policies and processes” (P15).

1 Offshore New England is a notably busy space (St. Martin & Hall-Arber, 2008;
2 Turnipseed et al., 2009). The “out of sight and out of mind” argument has been critiqued by
3 fishing groups, environmentalists, and others critical of offshore aquaculture expansion in the US
4 (e.g., Benjamin 2002; Food & Water Watch 2011; Skladany, Belton, and Clausen 2005). Calls
5 for development that generalize or take as given offshore waters as sparsely used and open to
6 large-scale development are likely overstating actual conditions (e.g., O6, P19). In such high-use
7 offshore areas conflicts are not only inevitable, but may be difficult to manage. According to one
8 informant, “no matter where you go in that ocean, you’re going to be impacting the
9 stakeholders” (O3). Moreover, some informants speculated that spatial conflicts will only
10 intensify as the industry expands. One informant related an exchange with a lobsterman while
11 discussing an offshore site at a public meeting:

12 [T]he head [or] the executive director of the Lobsterman’s Association was there and
13 said, “This is OK, we’ll let you guys do your little experiment, but we really think of this
14 [offshore aquaculture operation] as kind of a cancer. It’s going to start and there’s going
15 to be one little cell that’s dead, and then it’s going to spread through the sound, and then
16 we’re going to be displaced from our fishery and lose our livelihoods.” (P13)
17

18 Concerns over these types of conflicts are not confined to research informants. Emerging
19 management processes such as marine spatial planning (MSP) are specifically designed with
20 these issues in mind, and seek to address spatial allocation, displacement, and conflict through
21 regional stakeholder engagement and comprehensive mapping (National Ocean Council, 2013).
22 However, even here offshore aquaculture proponents are skeptical that MSP would help industry.
23 Instead, some informants perceive that more powerful groups (such as environmentalists, energy
24 interests, and commercial fishermen) will dictate spatial allocations, disempowering
25 aquaculturists in planning discussion and leaving industry with only “leftovers”—offshore
26 spaces that may not see other uses, but that are also undesirable for growing mussels and other

1 organisms (O7, P4, P37). As a result, while moving mussels offshore will reduce conflicts and
2 other issues with coastal landowners and users, it will not reduce all social and political conflicts
3 over space, either in management processes or at sea.

4

5 **4.3 Tensions in addressing the challenges for offshore mussel aquaculture**

6 Results show much consensus among interview participants in identifying and describing
7 the challenges and opportunities for offshore mussel aquaculture. These results are summarized
8 in Table 1. Technical, environmental, and market conditions were generally deemed favorable to
9 development, while financial and regulatory conditions were considered more problematic.
10 Perceptions of social and political conditions were mixed, as they present both challenges and
11 opportunities. Generally speaking, both groups of informants—ocean users and policy
12 practitioners—shared consistent perceptions of these conditions, although ocean users were more
13 concerned with financial issues, perhaps because their activities are more closely linked to
14 practical financial considerations. This general agreement across informants, however, belies
15 tensions over how challenges should be addressed.

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1 **Table 1.** Summary of New England stakeholder perspectives (n=41) on the conditions to offshore mussel
 2 aquaculture expansion, determined from interview data (some informants did not discuss all conditions;
 3 those responses labeled N/A).
 4

Conditions	Feasibility	No. of Informants		
		O (n=21)	P (n=20)	Total (n=41)
Technical	<i>Favorable</i>	12	14	26
	<i>Neutral/Mixed</i>	3	3	6
	<i>Problematic</i>	3	1	4
	<i>N/A</i>	3	2	5
Environmental	<i>Favorable</i>	15	13	28
	<i>Neutral/Mixed</i>	5	6	11
	<i>Problematic</i>	0	1	1
	<i>N/A</i>	1	0	1
Market	<i>Favorable</i>	20	14	34
	<i>Neutral/Mixed</i>	0	0	0
	<i>Problematic</i>	0	1	1
	<i>N/A</i>	1	5	6
Regulatory	<i>Favorable</i>	0	2	2
	<i>Neutral/Mixed</i>	6	6	12
	<i>Problematic</i>	13	10	23
	<i>N/A</i>	2	2	4
Financial	<i>Favorable</i>	3	5	8
	<i>Neutral/Mixed</i>	1	2	3
	<i>Problematic</i>	16	7	23
	<i>N/A</i>	1	6	7
Social/Political	<i>Feasible</i>	4	5	9
	<i>Neutral/Mixed</i>	8	6	14
	<i>Problematic</i>	5	8	13
	<i>N/A</i>	4	1	5

5
 6
 7 Interest in expanding industry on a large-scale is confronted by competing regulatory
 8 challenges as well as interests in maintaining small-scale livelihoods and moderating large
 9 corporate influence offshore. As one informant noted, “[i]ndustry wants to see more of a public
 10 demonstration before they go full stream with [offshore mussel aquaculture]” (P7), and a

1 common assertion is that this first mover should be a large, well-funded company. With the
2 resources to take on the time, cost, and risk to navigate the current policy framework and
3 associated regulatory and financial conditions, such a company could motivate others to follow.
4 However, this assertion simplifies and obscures other concerns and challenges discussed by
5 some of those same informants and many others. In particular, expansion by large or foreign
6 companies may be socially undesirable to some stakeholders and communities. Such
7 development risks crowding out small producers and transforming the livelihoods of existing
8 fishermen and aquaculturists (O4, O11, O18; cf. Marshall, 2001). Further, these companies risk
9 exacerbating social conflicts with other offshore stakeholders, who may view corporate
10 aquaculture as a contentious privatization of space or environmental risk. However, these types
11 of investments may be necessary to meet national policy goals and informants' long-term desires
12 regarding expansion (and may not always be undesirable to local stakeholders; see Safford and
13 Hamilton, 2011), as individual fishermen or inshore aquaculture producers struggle to afford
14 large-scale offshore operations given the scale, gear, and costs necessary to be profitable.

15 Furthermore, cautious optimism regarding broad legislative and regulatory change is
16 confronted by the realities and ramifications of such a transformation. While new national
17 legislation may be necessary for long-term industry growth, (e.g., Knapp, 2012; Stickney, 2006),
18 a difficult "chicken-or-egg" problem (O11, P4, P37) is implicit in this process: although an
19 improved regulatory environment is important to attract large-scale commercial interest, that
20 interest and accompanying political will may first be necessary to mobilize any legislation. Some
21 informants likened the requirements of such a political shift to a new "space race" (O17) or
22 "putting a man on the Moon" (O21), requiring ambitious, costly, and difficult tasks such as broad
23 education initiatives that combat critical discourses of seafood farming among environmental

1 groups, the public, and the oceans research and policy communities (e.g., O8, O14, P4, P17,
2 P18). At the same time, while “setting a regulatory framework might be necessary” for industry
3 growth, it may also be insufficient (Upton and Buck 2010, p. 20) and unrealistic under the
4 current social and political conditions described. Actual growth may instead be driven by local,
5 regional, and industry initiatives, with or without the presence of new federal regulation (Knapp,
6 2008; Upton and Buck, 2010). Many informants stressed non-regulatory intervention at these
7 scales (e.g., funding, regional collaboration, informal stakeholder coordination, applied research
8 initiatives), in addition to or in lieu of formal regulatory change.

9

10 **5. DISCUSSION: OPPORTUNITIES AND IMPLICATIONS FOR MANAGEMENT**

11 **5.1. Targeted and non-regulatory government intervention**

12 Different opportunities for management interventions exist to address the challenges and
13 tensions inherent to offshore mussel aquaculture in New England. Many informants seek a
14 nuanced role for government involvement in the near-term. As described, this role involves
15 restraint from some offices and agencies (i.e., those “precautionary” branches focused on
16 resource protection) but more targeted involvement from others (e.g., the NOAA Office of
17 Aquaculture). Alternatively, greater communication and cooperation across *all* agencies, offices,
18 and scales of government, could enable more mutually beneficial, sustainable aquaculture (or
19 “ecological aquaculture;” see Costa-Pierce, 2010).⁵ Consequently, a shift in management
20 dialogue from emphases on national policy, regulation, and basic research initiatives to more
21 “actionable” (P18) interventions focused directly on commercial operations at the local and
22 regional scale may hold promise for jump-starting sustainable industry development.

⁵ The federal Inter-Agency Working Group on Aquaculture is an example of such an effort, bringing together elements of federal agencies to coordinate aquaculture activities, but local and regional initiatives are also necessary.

1 According to informants, the federal government can and should provide clear and
2 tangible support for offshore aquaculture through, for example, revolving loan funds, matching
3 business development grants (in addition to or in lieu of existing research-oriented grant
4 programs), or a system of enhanced extension and outreach mirroring the Department of
5 Agriculture’s experimental farm program (O8, O17, O19). Government loans, for instance,
6 would help allay difficulties securing financing from banks and private investors that do not
7 recognize Army Corps permits as “bankable” (O13) investments. Further, while broad education
8 programs may hold long-term value, directly engaging the specific regulators and agency offices
9 charged with mandates affecting offshore mussel farming may have more immediate impact.
10 Despite the current piecemeal process, the network of *individuals* involved in most permitting is
11 relatively small, and could be amenable to greater coordination and information-sharing. This
12 would increase agency familiarity with the industry, limit miscommunications, and perhaps
13 achieve a better desired “balance” regarding offshore development and environmental protection
14 among stakeholders. Lastly, collecting, summarizing, and publishing the *actual* paths that
15 offshore mussel operators have taken to secure permits will provide a more transparent
16 demonstration of the steps involved offshore. This will clarify regulatory confusion surrounding
17 permitting processes in the EEZ, as the theoretical permit process either remains unknown,
18 unclear, or unrealistic to many interested parties in practice.

19

20 **5.2. Local, regional, and informal coordination**

21 An increased focus on local and regional management and development initiatives could
22 be productive for offshore mussel aquaculture. While social conflicts and regulatory
23 miscommunications may impact offshore development, informants were optimistic that many

1 disagreements and management issues could be alleviated through negotiation at the local scale.
2 In particular, they highlight the value and importance of informal and face-to-face discussions
3 with other offshore users to negotiate spatial conflicts, instead of strictly formal management
4 processes. These interactions provide ways to explain and discuss offshore aquaculture—an
5 otherwise unfamiliar and new use for many ocean users, managers, and regulators—and find
6 mutually appropriate sites for development.

7 For some informants, the confidence in such processes offshore derives from successes
8 inshore, where pre- and post-application meetings with community members and other
9 stakeholders have proven helpful to alleviate conflicts in New England state waters (O18, P2, P3,
10 P5, P8). One aquaculturist noted the efficacy of this approach inshore: “[the] biggest thing that
11 we did is when we got our site, we got to know the community, [and] talked to people” (O15).
12 This was echoed by others, as researchers, government actors, and industry members alike
13 stressed the importance of community participation in aquaculture planning both inshore and off
14 (e.g., O11, P5, P8, P18). One informant had hope for the federal offshore process to “in some
15 respects mimic the state process...where there are good opportunities to make sure there is some
16 local connection [...that] reflects local concerns, local conditions, local knowledge, and ability”
17 (O18). As a result, despite informants’ skepticism about MSP, in EEZ waters it may yet provide
18 a useful regime for this type of management interaction. It seeks to offer dedicated regional
19 forums for offshore aquaculture and other stakeholders to share and negotiate their perspectives,
20 where governance involvement and authority from other scales (state and federal) is limited. This
21 provides an opportunity for discussion toward mutual agreement about the extent and location of
22 aquaculture development and other activities (Pomeroy & Douvère, 2008; cf. Wiber et al., 2010).
23

1 **5.3. Community-based and cooperative initiatives**

2 In addition to local-level planning and conflict resolution, informants also suggested there
3 is a “huge potential for driving [investment] from a community level” (P17). Especially for
4 offshore mussel operations and potentially cheaper efforts, such as macroalgae aquaculture, “you
5 have communities buying into aquaculture and therefore that helps with the permitting issues;
6 that helps with the investment issues (P17).” As a result, one actionable model to alleviate some
7 of the challenges associated with offshore mussel aquaculture expansion may involve
8 encouraging and supporting cooperatives. Cooperatives are common in agriculture, growing in
9 commercial fisheries, and already exist for some aquaculture sectors including mussels, catfish,
10 trout, clams, and oysters (Pinto da Silva & Kitts, 2006; Cush & Varley, 2013; Pitchon, 2011;
11 Pomeroy, 2010). They build on the benefits of clustering economies, and take advantage of
12 geographic proximity between offshore operators both on land and at sea. This creates
13 economies of scale and cost savings for members, while also dispersing risk throughout the
14 cooperatives (Hoagland et al., 2003).

15 A cooperative model that engages communities and likeminded industry members could
16 take on various forms to make offshore mussel farming financially viable and socially
17 acceptable. This builds on policy goals and efforts to enhance seafood production and
18 community resilience in the US (DOC, 2011; NOAA Fisheries, 2011; NOAA, 2011b; Clay &
19 Olson, 2008), as well as evidence suggesting coastal communities and fishermen may be
20 amenable to increased aquaculture in New England and participation in offshore development—
21 particularly in places already accustomed to seafood farming (Safford & Hamilton, 2011; Tango-
22 Lowy & Robertson, 2002). Cooperatives are a potential means to secure capital for large-scale
23 operations, providing for dedicated mussel farming boats or processing equipment, such as those

1 found in mature offshore mussel industries overseas, without necessarily requiring large seafood
2 companies (O8; Cush & Varley, 2013; cf. Pomeroy, 2010). For example, a “marine industrial
3 park” could involve subletting permitted space to individual offshore farmers, who may share
4 gear, boats, or initial permitting costs. Cooperatives may also be linked or give rise to related
5 alternative business models, such as community-supported fisheries (CSF) and other direct
6 marketing initiatives that seek to better connect operators to consumers and may also provide
7 more up-front capital and stable incomes for producers (Brinson et al., 2011; Campbell et al.,
8 2014), further alleviating some of the financial and social challenges to offshore development.
9 Other models could directly engage commercial fishermen, building on the commonalities
10 between the fisheries and aquaculture sectors rather than focusing on their perceived adversarial
11 relationship in planning (e.g., O3, O13, P19).

12 Including fishermen directly as participants in offshore projects can add critical
13 knowledge, rapport, and legitimacy to siting and development processes, helping to avoid
14 conflicts while also providing ready gear and boats for initial operations (e.g., P5, O4). This also
15 offers opportunity for new or supplementary forms of income for fishermen and related onshore
16 industries—an important aspect toward maintaining the stability of local fishing-dependent
17 communities (O4, O13; cf. Pitchon, 2011). Indeed, the few existing or previous offshore mussel
18 projects in New England have successfully included fishermen in planning and operation, and
19 may provide worthwhile foundations to develop full offshore aquaculture cooperatives. Lastly,
20 cooperatives create stronger networks between operators, and provide members “greater
21 bargaining power” than they would have individually (Pomeroy, 2010). In addition to purchasing
22 inputs at lower cost, this could give the offshore mussel community a stronger political voice in
23 collaborative ocean governance processes such as MSP, allowing them to negotiate and ‘claim’

1 offshore spaces for sustainable development (Olson, 2010; St. Martin & Hall-Arber, 2008; cf.
2 Pinto da Silva & Kitts, 2006).

3

4 **5. CONCLUSIONS**

5 As the New England mussel aquaculture sector, and the US more generally, seeks to
6 increase domestic marine aquaculture production and move operations into offshore
7 environments, examining stakeholder perceptions provides us with insight into how that industry
8 may develop, and the challenges and opportunities facing it. The results of this research broadly
9 align with many existing explanations for slow marine and offshore aquaculture growth in the
10 US (e.g., Knapp, 2012; Cicin-Sain et al., 2001), however they also demonstrate the importance
11 of engaging stakeholders and interrogating marine aquaculture issues at the local and regional
12 level. Opportunities, challenges, and tensions in policy and development may be context-
13 specific, offering unexpected obstacles or creative solutions for stakeholders that may otherwise
14 be overlooked.

15 Stakeholders in New England perceive regulatory and financial conditions as the primary
16 challenges facing offshore mussel aquaculture expansion. Technical, environmental, and market
17 conditions are generally deemed favorable, or more easily manageable, for expansion. There is
18 greater uncertainty about social and political conditions. While moving mussel aquaculture
19 offshore escapes many of the adversarial social conflicts inherent with inshore activity, it also
20 moves industry into unfamiliar spaces that, contrary to some assertions, are busy with different
21 uses, management schemes, and stakeholders—some of whom may also be opposed to
22 aquaculture. Further, tensions surrounding the nature of offshore operations and the scope of
23 government involvement need to be addressed. While large seafood companies may be

1 financially viable candidates to spur offshore industry and are desired by some stakeholders, they
2 may also be limited by existing regulations or social and political resistance. Similarly, whereas
3 broad regulatory change will encourage offshore development, it is a difficult endeavor. Targeted
4 government involvement may be more productive in the near term, and an increased emphasis on
5 actionable government interventions at the local and regional scale are most desirable to
6 proponents of offshore expansion. More specifically, stakeholder perspectives suggest that
7 increased focus on informal and face-to-face discussions regarding siting, cooperative mussel
8 aquaculture initiatives, and more equitable enrollment of offshore aquaculture into MSP and
9 other ocean planning processes may hold promise for development. While none is a panacea,
10 these strategies can provide productive starting points to responsibly expand mussel and other
11 marine aquaculture offshore in New England and elsewhere.

12

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