



The Nelson A. Rockefeller Center at Dartmouth College

The Center for Public Policy and the Social Sciences

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**DEVELOPING NEW HAMPSHIRE AQUACULTURE  
REGULATION**

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*A Comparative Case Study of Eastern Coastal States*

Presented to the New Hampshire Department of Environmental  
Services, Wetlands Bureau

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Prepared By:

Mary Katherine Andrews

Michael Baicker

Priya Ramaiah

Ke Zhao

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Contact:

Nelson A. Rockefeller Center, 6082 Rockefeller Hall, Dartmouth College, Hanover, NH 03755  
<http://rockefeller.dartmouth.edu/shop/> • Email: [Ronald.G.Shaiko@Dartmouth.edu](mailto:Ronald.G.Shaiko@Dartmouth.edu)



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## **EXECUTIVE SUMMARY**

Aquaculture is a burgeoning industry in New England, but current aquaculture policy in New Hampshire requires additional infrastructure to adequately allow for economic growth. Due to the lack of a regulatory framework, aquaculturists are currently able to erect illegal structures and operations on public lands. The New Hampshire Department of Environmental Services (DES) desires a greater level of state oversight as it attempts to expand upon the existing state statutory framework. To assist the DES in this process, we evaluate the state aquaculture policies of Massachusetts, New Jersey, and Maine, specifically focusing on each state's permitting processes, enforcement, and treatment of public trust lands. A final analysis of these three states provides a useful state-by-state comparison for New Hampshire in developing aquaculture regulation.

## **1. INTRODUCTION**

Home to over a hundred miles of coastline and tidal areas, New Hampshire wishes to expand and regulate its aquaculture industry. The New Hampshire Department of Environmental Services (DES) currently faces a variety of challenges in regulating aquaculture and seeks to design a plan to rejuvenate its regulatory infrastructure. It is the mission of the DES to provide for the “protection and wise management of the state of New Hampshire’s environment.”<sup>1</sup> As part of this mission, it desires increased oversight, unification, and efficiency in its aquaculture program.

Currently, the New Hampshire Department of Fish and Game (DFG) is the sole agency responsible for issuing aquaculture licenses.<sup>2</sup> DFG provides licenses that allow the propagation of species such as oysters, blue mussels, and other shellfish, but have few rules pertaining to the permitted location of aquaculture structures<sup>3</sup>, leading to conflicts within Public Trust lands. Because public waters are required to be available for fishing, boating and recreation, permanent aquaculture operations that impede the ability of the public to use these waters present a problem for the state.

Our research addresses existing policies in place for Massachusetts, New Jersey, and Maine, employing a state-by-state comparative case study approach. These three states have been identified as suitable for comparison based on a large set of variables, including their aquatic climates, harvested species, and existing regulatory mechanisms. Our comparison also addresses the reconciliation between aquaculture operations and recreational uses of the Public Trust, culminating in an analysis of the three different procedures and their potential advantages and disadvantages.

## **2. MASSACHUSETTS**

Due to the high cost of coastal land as well as the Commonwealth’s designation of seacoast for other uses, the size of the aquaculture industry in Massachusetts is modest. Even by the highest estimates of production, aquaculture provides less than three percent



of all marine catches in the state.<sup>4</sup> Aquaculture operations are almost exclusively concentrated in southeastern Massachusetts, with quahogs, oysters, and blue mussels accounting for the majority of cultured species.<sup>5</sup> In 2012, there were 378 active aquaculture licenses to 156 registered shellfish farms covering 1,030 acres.<sup>6</sup> Since 2007, the number of aquaculture licenses has increased by twenty percent.<sup>7</sup>

## *2.1 Description of Process*

Broad frameworks governing aquaculture operations are promulgated at the state level by the Division of Marine Fisheries (Marine Fisheries). For example, Marine Fisheries uses water quality metrics to map out Designated Shellfish Growing Areas that are approved, conditionally approved, restricted, or prohibited.<sup>8</sup> However, the majority of aquaculture regulations—including specific permit requirements, oversight, and jurisdiction—are determined at the municipal level.

While a few towns allocate small plots of coastal shore or sea bottom to shellfish aquaculturists, many towns choose a more segmented approach, in which shellfish applicants are responsible for their own site selection.<sup>9</sup> In addition, while some towns impose strict performance requirements that shellfish growers must meet every year to keep their permit (e.g., Mashpee requires that shellfishermen plant at least 110,000 shellfish per year<sup>10</sup>), others have additional commercial licensing requirements, while others still enforce seasonal harvesting limitations. The variance that arises from Massachusetts' unique "home rule" approach to aquaculture permitting is what makes the state a key point of comparison in the development of New Hampshire aquaculture regulation.

At the state level, aquaculture operations in Massachusetts are subject to four categories of consideration. Depending on the type of activity, aquaculturists may be required to receive a permit for one or more of the following categories: the species to be cultivated, the discharge produced by the operation, the structures that will be required to sustain the facilities of operation, and the source of water. Additional short response questions required of each applicable category are found in the Massachusetts Aquaculture Permits Guidance Document.<sup>11</sup> The tables below, presented by category, summarize the eighteen types of permits that may be applicable to a broad range of aquaculture activities.



Table 1: Species

<b>Permit Type</b>	<b>Issuing Agency</b>	<b>Activities Covered</b>	<b>Cost</b>
Shellfish Grant Application	Local Board of Selectmen, Each municipality	Licensing for shellfish culture Activity on commonwealth tidal and subtidal lands.	\$5 to 25 per acre per year
Class I and III Fish Propagation Possession Permit	Division of Fisheries and Wildlife	Possession and propagation of (and sale of) aquacultured finfish: freshwater only.	\$100 \$100 renewal
Special Permit Application For Cultivation of Marine Finfish Species	Division of Marine Fisheries	Possession of regulated species, undersize species, non-indigenous species in tanks. Convention on International Trade in Endangered Species of Wild Fauna and Flora protocol must be followed.	\$10
Class VI Fish Propagation Possession Permit	Division of Fisheries and Wildlife	Retail permit for the sale of aquacultured products in food stores and supermarkets.	\$25 \$25 renewal \$25 per establishment
Dealer Permit	Division of Marine Fisheries	The wholesale or retail sale of marine shellfish, live, frozen or unfrozen.	\$65 to \$260
Aquaculture Permit	Division of Marine Fisheries	Possession of fish for purposes of propagation, sale, etc.	\$10 per year
Class IV Fish Propagation Possession Permit	Division of Fisheries and Wildlife	The cultivation, propagation or maintenance of reptilian or amphibian species that are wild by nature.	\$15 \$10 renewal



Table 2: Discharge

<b>Permit Type</b>	<b>Issuing Agency</b>	<b>Activities Covered</b>	<b>Cost</b>
Groundwater Discharge Permit	Dept. of Environmental Protection	Discharge of water into the ground.	\$3,000
National Pollutant Discharge Elimination System	Dept. of Environmental Protection	All point-source discharges into surface waters. Also requires EPA review.	N/A
Surface Water Discharge Permit	Dept. of Environmental Protection	Surface water discharge. Surface waters include rivers, streams, seaward lakes, ponds, springs, wetlands, downward impoundments, estuaries and coastal waters.	\$500 to \$1,600
Army Corps Permit	U.S. Army Corps of Engineers	Discharge of dredge or fill materials in Waters of the U.S.; including waters of the High Tide Line (HTL), streams from ordinary high water, and all wetland impacts. For shellfish aquaculture activities only.	\$0 to \$100
Request for Determination	Town Conservation Commission or Dept. of Environmental Protection	To determine if the project is subject to the jurisdiction of the WPA or if the project alters wetland resource areas.	Dependent on project



Table 3: Structure

<b>Permit Type</b>	<b>Issuing Agency</b>	<b>Activities Covered</b>	<b>Cost</b>
Federal Consistency Determination - CZM Consistency	Executive Office of Environmental Affairs	Any activity that may affect the land and water resources of the Massachusetts; including riverfront areas, and requires a Federal license or permit, or is Federally funded or a direct activity of a Federal agency; and is generally above the thresholds established by the MEPA.	None
Wetlands Permit Wetlands Protection Act	Local Conservation Commission or Dept. of Environmental Protection	All activity in or near any resource areas.	Dependent on project
Waterways License	Dept. of Environmental Protection	Structures within 200 feet of water; filled tidelands.	Dependent on project
ACOE Permit; PGP or Individual Permits	U.S. Army Corps of Engineers	Structures placed seaward of MHW or work in navigable waters including dredging.	\$0 to \$100

Table 4: Water Source

<b>Permit Type</b>	<b>Issuing Agency</b>	<b>Activities Covered</b>	<b>Cost</b>
Water Withdrawal Permit	Dept. of Environmental Protection	Water usage; quantities regulated if over 100,000 gal/day.	\$1,900 permit \$100 per year if accepted
MEPA Environmental Notification Form	MA Environ. Policy Act Office	1) Any ACEC-requiring activity, 2) Activities exceeding the review thresholds at 301 CMR 11.03 and 11.04. 3) Activities exceeding MCZM Consistency review	None



From these tables it is clear that obtaining the requisite permits for aquaculture operations involves multiple layers of approval at the local, state, and federal levels.

Two permits in particular, the Shellfish Grant Application issued by the Local Board of Selectmen of each municipality and the Aquaculture Permit issued by Marine Fisheries, are applicable and required of all aquaculture activity in the Commonwealth. The process for obtaining these two permits are outlined in the next section.

## *2.2 Permitting Process*

Per Chapter 130, Section 57 of the Massachusetts General Laws, all individuals seeking to use tidal or subtidal land for shellfish culture must submit a Notice of Intent (NOI) to the Local Conservation Commission, which acts on behalf of the Massachusetts Department of Environmental Protection (DEP).<sup>12</sup> Although the specifics of the local application process vary by municipality, is it often up to the individual to find a plot of land that is naturally unproductive and would not come into conflict with upland owner rights before filing the NOI.<sup>13</sup>

Site selection is often the most difficult stage of the permitting process. According to John Mankevetch, Assistant Shellfish Constable for the Town of Wellfleet, most towns are already at maximum capacity with regards to the sites that are both conducive to shellfish aquaculture and free from upland owner conflicts. For this reason, most permit applications are filed by established operations seeking annual permit renewal; only one or two new applications are received by the municipality each year.<sup>14</sup>

After the permit application is reviewed by Local Board of Selectmen, the Local Shellfish Constable, and the Local Conservation Commission, a public hearing will be held within a week to two months, depending on the frequency of town meetings. Because the primary criteria for the municipal Shellfish Grant Application is non-interference with riparian owner rights, during the public hearing process is when most public trust and “Not In My Backyard” (NIMBY) conflicts are resolved.<sup>15</sup>

Once municipal approval is granted, the Selectmen of each municipality apply on behalf of the applicant to Marine Fisheries for the Aquaculture Propagation Permit. At this stage, Marine Fisheries will authorize a biological survey of the proposed site of propagation to ascertain that the land is barren and will not be taking away from naturally occurring resources of the state or public trust. Furthermore, the biological survey is used to determine how to best control the introduction of non-native shellfish species or potential diseases and predators into state waters. Passing this, Marine Fisheries will issue a letter of approval to the permit applicant for possession of the sublegal site.

According to Jerry Moles, head of Marine Fisheries’ Shellfish Sanitation and Management Program, applications that reach Marine Fisheries are almost always





approved because the municipal stage works well in correcting or weeding out any areas of concern.<sup>16</sup>

Finally, depending on whether the aquaculture activity falls into other categories, applicants may need to seek additional approval from the Army Corps of Engineers and the DEP, among other entities, for compliance with environmental protection and coastal navigation regulations.

### *2.3 Enforcement*

Although the state will respond to concerns over public health or law enforcement, it is the municipality that is responsible for day-to-day enforcement of aquaculture sublegal siting conditions. These tasks typically include monitoring aquaculture sites that have raised concerns and mediating border disputes between owners. When a municipality receives complaints that the buoys marking the boundaries of a licensee's plot have moved either accidentally or intentionally, for instance, the local Shellfish Department will step in to place the buoys in their designated locations as determined by GPS coordinates.<sup>17</sup>

Some towns also utilize volunteer troops to assist with enforcement.<sup>18</sup> However, the level of enforcement varies by municipality due to differences in geographic area and the scope of responsibilities placed upon each municipality's Shellfish Department.

### *2.4 Public Opinion and Public Trust*

Massachusetts colonial ordinances dating back to 1641 grant upland owners claim to nearshore intertidal areas to encourage owners to develop piers and commercial coastline structures.<sup>19</sup> However, a riparian rights clause was codified to allow public access to the intertidal area for "fishing, fowling, or navigation".<sup>20</sup> Until the landmark Massachusetts Supreme Judicial Court ruling in *Pazolt v. Director of the Division of Marine Fisheries* (1994), aquaculture was considered fishing and therefore exempted from upland owner rights. After the *Pazolt* ruling, however, aquaculture was deemed distinct from fishing and no longer protected under the public trust doctrine.<sup>21</sup>

Since 1994, shellfish licensees have been required to obtain permission from private upland property owners to conduct aquaculture operations—a change that underlies many legal disputes heard by the Massachusetts judicial system to this day. Moreover, while Chapter 130, Section 57 of the Massachusetts General Laws enumerates specific ownership rights of aquaculturists to their shellfish and operational facilities as well as protections against willful damage by others, many municipalities are clear to state in their terms of licensing that permits do not convey property rights.<sup>22</sup> This means that aquaculturists cannot use their license as a defense against actions of trespassing on upland owner property; it is up to individual shellfishermen to obtain permission from property owners.



Upon initial inspection, the setup of Massachusetts' aquaculture regulatory framework, given its town-by-town approach, appears highly effective in mitigating public trust issues. At the municipal level, towns take care of fee collection, day-to-day enforcement, and local disputes. Towns are also able to decide whether to impose more stringent local regulations on top of broader existing state guidelines. By the time that applicants file for the state propagation permit with Marine Fisheries, they have already passed the local approval process and thus have cleared the hurdle of the mandatory public hearing process.<sup>23</sup>

This does not mean, however, that Massachusetts has been completely successful in navigating the litigation crossfires between upland owners and aquaculture licensees. In fact, an examination of municipal public hearing records and court courses on MassCases.com point to the nonresolution of the public trust issue.<sup>30</sup> Records from an August 2013 meeting of the Town of Eastham, for example, document a case in which an upland property owner was never notified of the public hearing for an aquaculture permit.<sup>24</sup> This is a recurring issue documented by meeting minutes in various different towns.<sup>25</sup> Disputes over upland owner rights and aquaculture operations are equally abundant in the judicial system, and has led to towns enacting their own, more stringent wetlands laws.<sup>26</sup>

Indeed, while executive agencies such as Marine Fisheries tend not to bear witness to public trust issues owing to the state's municipal approach with regards to the permitting process, it may be possible that these issues are bubbling up in the judicial system instead. However, according to the 2003 "Best Management Practices for the Shellfish Culture Industry in Southeastern Massachusetts" report prepared by Massachusetts shellfish growers in collaboration with the Southeastern Massachusetts Aquaculture Center (SEMAC), the best way to mitigate issues of public trust may simply be at the municipal level before aquaculture operations ever begin: by researching any upland owner rights on a case by case basis and arranging for permission with the owner prior to filing the NOI.<sup>27</sup>

Nonetheless, the importance of addressing aquaculture siting issues by the state as a whole were recently confirmed as a priority for the Commonwealth in its 2015 Ocean Management Plan.<sup>28</sup> A fisheries technical work group is currently tasked with examining the issues surrounding land tenancy in light of preserving existing municipal and state jurisdictions.

### *2.5 Economic Impact*

On the one hand, many of Massachusetts' aquaculture farms are local, family-run businesses that have been operating for decades.<sup>29</sup> On the other hand, the state is also home to several large-scale aquaculture establishments. For example, Australis Aquaculture, one of the largest indoor aquaculture operations in the world, is located in



Turners Falls, Massachusetts, providing employment to some fifty workers who produce over one million pounds of fish every year.<sup>30</sup>

According to the 2012 Census of Aquaculture, Massachusetts was the seventh largest producer of cultivated shellfish in the U.S., a rank that has remained steady over the last decade.<sup>31</sup> The total value of aquaculture operations in Massachusetts in 2012 was \$15.4 million.<sup>32</sup>

The average annual wage of workers in marine aquaculture is \$23,000. However, some employees are part-time and others still are aquaculture hobbyists.<sup>33</sup> In fact, commercial aquaculture is only one aspect of the industry. Aquaculture also occurs in laboratories for scientific research and development, a sector of research in the state that receives over \$50 million in research grants annually. In addition, public restoration and propagation efforts of diminishing populations are pursued by most coastal towns, constituting ten percent of the total harvest.<sup>34</sup> Finally, expanding populations, demand from seafood industries, and rising income levels in coastal areas are all expected to promote further growth in the aquaculture industry in coming years.<sup>35</sup>

Two prominent sources of economic loss faced by marine aquaculturists are natural disasters and ecosystem imbalance. Oxygen depletion, freeze, diseases, hurricanes, salinity changes, tidal waves, storms, and ice floes all pose threats to the success of a harvest.<sup>36</sup> In recent decades, the U.S. Department of Agriculture (USDA) Risk Management Agency has piloted hard clam crop insurance programs to mitigate these risks.<sup>37</sup>

## *2.6 Environmental Impact*

With over 1500 miles of coastline interspersed with rivers and estuarine systems to support the growth of shellfish and finfish in high quality coastal waters, Massachusetts exhibits a natural productivity extremely conducive to aquaculture.<sup>38</sup> However, the 10,500 acres of productive shellfish beds located on Cape Cod are prohibited, by statute, from aquaculture licensure.<sup>39</sup> Thus, the current size of aquaculture operations—which spans 1,030 acres of naturally unproductive wildbottom—represents less than ten percent of the total tidal flat area in southeastern Massachusetts.<sup>40</sup>

Massachusetts has taken a conservative approach to the management and approval of aquaculture operations in part due the uncertainty attributed to scaling aquaculture quickly. For example, risks of disease, predation, genetic contamination, chemical toxins, and eutrophication are all concerns that prevent the state from encouraging the acceleration of aquaculture development. Moreover, conversations with Local Shellfish Constables and State Extension Specialists have revealed that many towns are already operating at full capacity, with not much room for new aquaculture plots without experiencing a common resource problem.<sup>41</sup>



Currently, shellfish farming along the Northern coast of Massachusetts is prohibited by Marine Fisheries due to concerns over water quality and species protection.<sup>42</sup> Additionally, the state has conditionally approved or conditionally restricted areas classified by high sensitivity to ecosystem stress or harvesting restrictions. According to Diane Murphy at the Woods Hole Sea Grant and Cape Cod Cooperative, these areas tend to be located at the mouth of a river, where chemical pollutants may enter the system and become a pollution hazard.<sup>43</sup>

Depending on the species, the ideal salinity and tidal location of an aquaculture operation will vary. However, soft bottom muds are generally not conducive to aquaculture due to potential contaminants and siltation. Moreover, while phytoplankton is an important aspect of the shellfish diet, point-source pollutants, upstream runoff, and restricted light sources all threaten the livelihood of phytoplankton. Nitrogen enrichment, algal bloom, embayment, and eutrophication also contribute to changing dissolved oxygen levels, further threatening the already high mortality rates of many shellfish life cycles.<sup>44</sup> The success of shellfish aquaculture is thus very sensitive to environmental imbalances and requires the utmost care in preserving the health of the natural waters of the state.

To combat the issue of nitrogenous growth in particular, the DEP piloted three case study projects on Cape Cod, establishing watershed-based permitting systems in each of the Popponesset Bay, Three Bays, and Pleasant Bay estuaries.<sup>45</sup> The projects were undertaken between 2004 to 2006 to encourage inter-municipal coordination as well as to develop a system for nitrogen trading. Although developing common monitoring requirements was a significant hurdle, joint planning was key to mitigating wastewater, reducing septic loads, and slowing nitrogenous growth, evidencing that watershed coordination—even in a state where “home rule” rules—can be used successfully to combat water quality concerns.

### **3. NEW JERSEY**

New Jersey’s marine shellfish aquaculture history stretches back to the 1800s, when the Delaware Bay served as one of the largest producers of eastern oyster in the world.<sup>46</sup> Regulation of the industry did not begin until 1997, with the New Jersey Aquaculture Development Act (NJADA).<sup>47</sup> The NJADA created permitting requirements for a variety of possible aquaculture operations, and gave regulatory power to agencies such as the Department of Environmental Protection (NJDEP), Department of Health (DOH), and the Division of Fish and Wildlife’s Bureau of Shellfisheries. In 2011, New Jersey announced plans to consolidate and reevaluate their aquaculture policies, a process which continues today.



### 3.1 Description of Regulation

New Jersey currently has two models in place for those who wish to start commercial aquaculture farms. Operations that desire to harvest in an area that has not been pre-approved by the state must go through an application and permitting process overseen by the NJDEP. Possible permits that may need to be obtained include: Waterfront Development Permit, Coastal Wetlands Permit, Water Quality Certificate, Tidelands Instruments Permit, and Land Use Permit.<sup>48</sup>

Recently, New Jersey developed a network of pre-approved areas for aquaculture industry known as Aquaculture Development Zones (ADZs), located in both offshore and intertidal environments. ADZs have their own application procedure, but do not require additional permitting, as they have already been approved by the state. One shared feature of both models is the necessity for two licenses: an Aquatic Farmers License and a Shellfish License. A breakdown of the various licensing structures can be found in the table below.

Table 5: Structure

	<b>Aquatic Farmer License</b>	<b>Shellfish License</b>	<b>ADZ 2 &amp; 3</b>	<b>ADZ 4</b>
Description	Required of any farmer wishing to partake in finfish or shellfish aquaculture of value greater than \$2,500/year.	Required of any farmer wishing to harvest shellfish.	Offshore. 10 acres per lot, with possible expansion to 20 acres.	Nearshore. 1.5 acres per lot, with possible expansion to 3 acres.
Cost		\$50 Resident \$250 Non-Resident	Application fee of \$1,000 \$25/acre/year \$30 hydrographic survey fee per corner	Application fee of \$1,000 \$100/acre/year \$30 hydrographic survey fee per corner
Duration	5 years	1 year	5 years	5 years
Processing Time	New: Entire process could take several years	Instantaneous	Approximately 3 months	Approximately 3 months



	Existing Renewal: 3 months			
Required Public Hearing	No	No	No	No
Size of Operation	Greater than \$2,500 in value per year.	Any harvest of benthic mollusks	10-20 acres	1.5-3 acres
Renewability	Renewable	Renewable	Renewable	Renewable

As previously mentioned, operations outside of ADZs require a much more thorough permitting process and often involve a maze of regulatory activity. Each application is reviewed and assessed in order to determine its individual permit requirements. These permits are processed by their respective agencies, and all must be obtained before obtaining approval for a lease. Individuals may be denied on an individual permit basis, but will work with the appropriate agency to amend any reasons for denial. As a whole, very few applications for leases are ultimately denied, though the entire process can take up to several years to complete. As a result, some operations will begin setting up their equipment before all proper permits have been obtained.

The Aquaculture Development Zone lots are a new program in New Jersey, and are currently running on a five-year pilot program. The goal of the ADZs is to encourage new shellfish culture techniques. There are three ADZs available for lease (2, 3, and 4) and the state holds all necessary permits, making it easier for potential interests to begin farming aquaculture; all are located in the Delaware Bay. ADZ 2 and 3 are offshore areas, and are 500 and 600 acres respectively. ADZ 4 is in a nearshore, intertidal environment, and is only 36 acres. It is difficult for the state to expand the program because riparian landowner approval is part of the Tidelands License Review, and most refuse to approve of expansions to the program.<sup>49</sup>

As of 2015, there are only twelve 1.5 acre plots available in ADZ 4, and all have been leased. The waitlist for ADZ 4 lots currently stands at nine applicants. Because they are located in intertidal zones, ADZ 4 lots are the most desirable of all current ADZs. Lots in ADZ 2 and 3 are both larger and more widely available, at a total area of 1,100 acres compared to 36, but less than 100 acres have been leased. This is largely due to the nature of equipment needed for offshore, deep water shellfish culture, which is both expensive and uncommon among farmers in the area.<sup>50</sup>

### *3.2 Permitting Process*

Detailed instructions for obtaining approval for aquaculture projects in New Jersey can be found in the *Guidebook to Developing Aquaculture in NJ*.<sup>51</sup> The basic procedure for non-ADZ applications is as follows:





## I. State Regulatory Approval

The NJDEP will review the project for any possible environmental concerns and alert the applicant to the need for specific permits. At the same time, the NJDEP will review the Application for Aquatic Farmer License and gather as much information as possible to speed up the process.

1. The applicant creates a base map of the property they wish to use for agricultural purposes.
2. The applicant identifies if any area within the base map contains wetlands. If wetlands are included within the property, appropriate permitting and regulatory measures must be met.
3. The applicant denotes where the operation will be located on site, and in the case of shellfish aquaculture, what their equipment looks like and where it will be found in the water.
4. The applicant provides a detailed written description of their aquaculture processes.

After these steps are followed, the NJDEP will denote any necessary permits and work with the farmer to approve the application.

## II. Local Review Process

Applications may also need to undergo a local review process, although this is rarer when applying for marine shellfish aquaculture. Local review processes generally oversee municipal permitting for the erection of buildings or construction. This may affect aquaculture corporations which both harvest and process their shellfish, but does not directly affect the harvesting aspect of aquaculture.

Additionally, if an aquaculture operation has existed since December 31, 1997, the farm is protected from unduly restrictive municipal regulations and public and private nuisance lawsuits by the New Jersey Right to Farm Act.

### *3.3 Enforcement*

Once an applicant has successfully obtained an Aquatic Farmers License, Shellfish License, and received approval for harvesting aquaculture products, there are very few instances where state intervention is necessary. Occasionally, a corporation or individual who is in the middle of the application process will begin to lay down their equipment in the water before all permits have been approved.<sup>52</sup> Very rarely, however, will this cause the state to seek punitive measures. Aquaculture Extension Program Coordinator Lisa Calvo of the Rutgers Haskin Shellfish Research Laboratory says that the state is aware of the difficulty in processing applications quickly and efficiently, and thus does not feel the need to shut down these operations.



Squatters, or aquaculturists who harvest shellfish without the proper permits, are rare in New Jersey. Lisa Calvo estimates there may be a total of five such individuals or commercial operations, but that the majority of these fall into the aforementioned category of individuals and corporations that are still waiting to receive all their permits. Any other squatting is too small to make a significant impression on the industry, and it would not be cost-efficient to impose fines.

### *3.4 Public Opinion and Public Trust Issues*

New Jersey does not hold public hearings for aquaculture proposals or applications, and so it is difficult to determine possible public complaints. Some permits, such as the Land Use Permit and Tidelands License, offer a 30-day public comment period, but records of these are not available to the general public and no permits filed for aquaculture operations in the past year have been denied due to a complaint. More common issues and concerns center around possible environmental violations of state regulations, but these are handled by the Department of Environmental Protection.

The state has attempted to expand their ADZs, but often run into riparian landowner complaints. It is for this reason that there is no ADZ 1; the original was made too complicated by seeking landowner approval. It is likely that landowner approval is not so much of an issue for individual permits due to their relatively small size. New Jersey's ADZs attempt to receive permission for hundreds of acres of waters, while most farms seeking small permits do not require this much space.

It is also worth noting that while New Jersey is one of the most densely populated states in the country, the areas where aquaculture operations take place are sparsely populated, thus providing less opportunity for public complaints. Oyster aquaculture occurs primarily on the Delaware Bay off the coast of Cape May and Cumberland counties.<sup>53</sup> Cumberland County was once an area of economic prosperity, but is currently home to fewer than 160,000 residents.<sup>54</sup>

### *3.5 Economic Impact*

The latest figures for New Jersey aquaculture quote the industry value at \$5,787,000 for farm-gate sales of aquaculture products. Using a fisheries multiplier of six, it brings the total economic contribution to the state to \$34,722,000.<sup>55</sup> This includes not only shellfish, but also finfish and algae. The largest contributor to the New Jersey aquaculture industry is hard clam harvests, which occur along the Atlantic coast. Current estimates place hard clams at an off-the-boat value of \$4 million per year. By comparison, oysters provide approximately \$1 million per year in off-the-boat sales.<sup>56</sup>

Studies on the economic effects of New Jersey's aquaculture are slim, compounded by the fact that regulation and documentation of the industry did not begin until the 1990s.





The Aquaculture Innovation Center of New Jersey is currently studying the economics of aquaculture in the state, and this data will be used as New Jersey continues adjusting its policies in the near future.

### *3.6 Environmental Impact*

As part of the Aquatic Farmers License, New Jersey has a set of Best Management Practices for agricultural aquaculture that limit potential environmental abuses.<sup>57</sup> The main focus of these BMPs are water quality, wetlands protection, wastewater treatment, water supply, and non-native species. A majority of the BMPs are directed at finfish aquaculture industries which occur in buildings, not on public waters. However, issues such as water quality and wetlands protection are addressed in the initial approval for an aquaculture operation through their individual permits.

Marine shellfish aquaculture also helps maintain water quality through filtering water. Mollusks such as oysters, clams, and mussels filter algae and other particulates out of the water as they feed. Areas such as the Chesapeake Bay have actually suffered from poor water quality in recent years due to the decline in shellfish. Furthermore, certain shellfish culturing techniques provide for increased biodiversity. Many aquaculturists will “seed” their waters by creating natural beds of crushed shells on the ocean floor on which the clams and oysters may propagate. These beds, combined with the growing shellfish, provide for miniature ecosystems in which other marine organisms can live.

## **4. MAINE**

Since the 1800s, the Maine coast has harbored many aquaculture operations. Aquaculture regulation in Maine dates back to 1975. These laws allow the Department of Marine Resources (DMR) to lease state-owned waters to aquaculture interests.<sup>58</sup> Blue mussels, oysters, and finfish represent the majority of species cultivated in aquaculture. Maine has been the number one producing state in marine aquaculture for 10 of the last 15 years.<sup>59</sup> The total sales and revenue generated from aquaculture comes second in the state to lobster fishing.

There are 1,293 total acres of aquaculture in Maine. Standard shellfish aquaculture leases total 577.42 acres, 30.58 acres of aquaculture are experimental shellfish and 1.48 acres are limited purpose.<sup>60</sup> Because Maine’s aquaculture industry is already so large, regulation tends to focus on limiting the negative externalities of marine aquaculture by tailoring each lease based on stakeholder feedback.

### *4.1 Description of Regulation*

Maine has three different leasing options and application processes. The Limited Purpose Aquaculture License (LPA) permits small aquaculture projects and requires only the



approval of the local harbormaster. There can be no more than three LPA licenses within three square miles.

The Experimental Lease is intended for businesses, individuals, or corporations, which permits three years of aquaculture. If the site proves suitable, experimental lease owners apply for a standard lease, which lasts 10 years. The basic differences between the three leases are summarized in the following table.

Table 6: Types of Leases<sup>61</sup>

	<b>LPA License</b>	<b>Experimental Lease</b>	<b>Standard Lease</b>
Cost	\$50/year	\$100 Application fee \$100/acre/year	\$1500 Application Fee \$2000 (finfish) \$100/acre/year \$1500 Renew fee
Duration	One Year	Three Years	10 Years
Processing Time	4-12 weeks	3 – 12 Months	No shorter than 8 months
Required Public Hearing	Signature of Harbor Master	If five or more people request a hearing during scoping session or upon Commissioner request	Yes
Size of Operation	Less than 400 square feet	Less than 4 acres	Up to 100 acres
Renewability	Renewable	Non-renewable, with the expectation of scientific experiments.	Renewable

The DMR Commissioner can include conditions concerning equipment, stock limits, and timing of operations, light and noise pollution, mandatory navigational and fishing access within the boundaries and water quality testing to mitigate any of these public trust and environmental concerns.<sup>62</sup> The ability to add these conditions explains why so few permits are denied. For example, in all operations that take place on eel grass ecosystems, the commissioner requires the lease owner to take certain precautions to avoid damaging their habitat. The commissioner can also address issues concerning sound, light, or routine water quality monitoring.

Most aquaculturists reach out to land owners before the public hearing to mitigate any concerns. Aquaculture operators are eager to work with landowners to reduce the risk of litigation. For example, in some of the decisions, operators agreed to only harvest during the early morning, during bad weather, or during cold times of the year in order to



prevent disrupting recreational boaters and kayakers.<sup>63</sup> Lease applicants curry favor with local fishers by allowing them to fish within lease boundaries and by returning any equipment that gets caught in their traps.<sup>64</sup>

It is fairly easy to get a standard lease after operating an experimental lease for three years as long as seriously complaints were not raised during that three-year period. The use of the experimental lease provides good feedback and allows DMR to prevent the establishment of an aquaculture site that has proven to be harmful. The experimental lease also gives the Commissioner an idea of what conditions to attach to the standard lease. For example, if the experimental lease created anoxic conditions, the Commissioner can include a requirement to monitor the water quality and remove dead mussels from benthic environment as part of the standard lease.<sup>65</sup> Applying for a standard lease without an experimental lease leads to a lengthier, more contested process, and a lease with more requirements that may be unnecessary.

Out of the 83 new lease decisions posted on DMR's website, only two leases have been denied.<sup>66</sup> Both were for marine aquaculture. The Commissioner rejected no lease renewals. DMR denied an LPA in Smith Cove because the proposed site was in a hurricane safe-haven, a popular sailing race route, near a sailing summer camp, and a popular yacht harbor. The presence of an aquaculture farm would have interfered with all those uses. The other denied applicant was a commercial farm applying for a standard lease to culture blue mussels. The proposed two-acre site was located in a very productive lobster fishery. The lease would have impeded ferry and tanker traffic. The proposed site was also within one nautical mile of another aquaculture farm. The applicant did not previously have an experimental lease, which most likely attributed to the application's rejection.<sup>67</sup>

#### *4.2 Permitting Process*

For the LPA, the applicant must notify riparian landowners and get the signature of the harbor master to verify there will be no interruption of public trust land use. Public comments are accepted when the lease is up for renewal.

For the standard and experimental leases, the applicant needs to provide an environmental characterization baseline that includes bottom characteristics, flora and fauna, and tide levels. The baseline must also include samples of the sediment to measure organic carbon concentration. These baselines serve to demonstrate how the environment changed as a response to the presence of aquaculture when a lease is up for renewal.<sup>68</sup>

The leases must also include a description of the navigation and fishing in the area as well as a signature from every riparian owner. The applicant must list the equipment and prove the equipment is the best available technology.<sup>69</sup>



Once the applicant has submitted the following information. A DMR representative visits the sight to verify the navigational and fishing use as well as the environmental baseline. Then, riparian owners, municipality officials, the applicant, and any relevant state or federal agency, are notified of the public hearing. The hearing is also advertised in the local newspaper.<sup>70</sup> After the hearing, the commissioner considers the following criteria before approving or denying a lease:

- Lease does not interfere with egress or ingress of riparian owner
- Aquaculture activities will not unreasonably interfere with navigation.
- Lease will not interfere with fishing, other uses of the area, and nearby aquaculture sites.
- No interference with ecosystem's ability to support local flora and fauna.
- Activities proposed for this site will not unreasonably interfere with the public use or enjoyment within 1,000 feet of beaches, parks, or docking facilities owned by municipal, state, or federal governments.
- Applicant has proved existing source of future harvest.
- No unreasonable impact of light will disturb boundaries of lease.
- No unreasonable impact of noise.
- Proposed activities comply with visual impact criteria.

The commissioner may adjust the terms of the lease to ensure that these criteria are not violated.<sup>71</sup>

#### *4.3 Enforcement of Regulation*

Maine's marine patrol enforces aquaculture lease conditions. During an interview with Cindy Burke, the paralegal assistant of the aquaculture department, she said aquaculture operations usually do not violate the contents of their lease. Common issues involve gear washing up on the shore and fishing outside limits accidentally due to gear drifting in harsh tides.<sup>72</sup>

One reoccurring issue with enforcement is ensuring aquaculture ceases in areas the DMR closes due to environmental contaminants like red tide. During those closures, an aquaculture operator is unable to take any oysters harvested in the contaminated water to market. The lack of economic incentive to continue operation ensures these aquaculturists follow this regulation.<sup>73</sup>

There have been two incidents of squatters in the past three years.<sup>74</sup> Squatting tends to be unprofitable in Maine because the oysters grown in state waters without a lease are considered part of the public trust. Thus, any oysters grown without a permit are prone to poaching. Again, this removes the economic incentive of having a large-scale aquaculture operation.



#### 4.4 Public Trust and Public Opinion

Numerous public comment and interveners during the experimental and standard lease application believe certain aquaculture operations infringe on their public trust rights to navigation, ecosystem services, fishing, and riparian access. The following table summarizes the kinds of stakeholder concerns found in 40 marine aquaculture decisions and the steps taken by DMR to mitigate these complaints.<sup>75</sup>

Table 6: Tabulated Public Comment Data

<b>Complaint</b>	<b>Number of Complaints</b>	<b>Category</b>	<b>Mitigation</b>
Interrupts Fishing	7	Economic Recreation	<ul style="list-style-type: none"> <li>- Allowing fishing on lease.</li> <li>- Returning fishing equipment caught in aquaculture gear.</li> </ul>
Ferry Barge Navigation	2	Economic	Allowing navigation on lease
Reduces Property Value	3	Economic	-
Disrupts recreational navigation such as kayaks, sailboats, rowboats, and canoes	7	Recreation	Allowing navigation on lease
Interference with Water Skiing, Tubing, and wind surfing	3	Recreation	Allowing navigation on lease
Risk of collision in foggy conditions	2	Safety	More noticeable buoy marking
Noise pollution from trying to ward off predators	3	Nuisance	<ul style="list-style-type: none"> <li>- Emit noise quieter and only under water</li> <li>- Find another way to deter predators such as nets</li> </ul>
Ruins the remoteness, solitude, and aesthetics of shore	5	Nuisance	-
Biological accumulation lowers dissolved	4	Environmental	<ul style="list-style-type: none"> <li>- Remove organic matter from benthic environment</li> </ul>



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oxygen			- Require routine water quality testing
Proximity to Public beach	4	Recreation	- Move proposed site before application - Agree not to harvest when beach is at peak use
Interference with Yacht club activities	2	Recreation Economic	-
Interference with worm harvesting	1	Economic	-
Concern for eel grass	4	Environmental	- Limit impact by following proven techniques
Estuary Interference	1	Environmental	-
Fecal Pollution, Smell, and Noise caused by waterfowl	3	Nuisance	-
Debris Washing Up	5	Nuisance Environmental	- Attempt to prevent debris from moving - Collect debris that made it to the shore
Density of Aquaculture operations in area	2	Environmental Recreational	-
Inadequate Notification by DMR	3	Process Related	-
Interference with Storm Anchorage	4	Safety	-
Threat to Seal Population	4	Environmental	-
Threat to Eagle Population	4	Environmental	-
High speed use of aquaculture boats causing soil erosion	1	Environmental	Going at a slower speed



Table 7: Categorized Public Comment Data

<b>Complaint</b>	<b>Number of complaints</b>	<b>Mitigated</b>	<b>Percent Mitigated</b>
Environmental	25	14	56
Recreational	25	21	84
Economic	15	9	60
Nuisance	13	8	62
Safety	6	4	67
Process Related	2	0	0

Most comments were directed toward environmental or recreational uses. However, a higher proportion of recreational uses were mitigated. This difference could reflect the ease with which a commissioner can mediate recreational issues by requiring the leased land be open for fishing and boating. While opening the lease to other uses solves some problems, the presence of a large operation can continue to disrupt navigation when it comes to windsurfing or tubing.

The commissioner cannot mitigate environmental concerns as easily because most environmental impacts are inherent to aquaculture. Introducing a species and equipment to the ecosystem inevitably disturbs wild native populations such as seals, eagles, or seagulls. Limited research has been done on the environmental effects of shellfish aquaculture so most environmental complaints are unsubstantiated. Environmental effects that have a large degree of scientific uncertainty such as the disturbance of eelgrass and anoxic conditions are mitigated.

The tables reveal the largest issues involving public trust rights were related to navigation, fishing, and ecosystem services. Surprisingly, there were few riparian concerns other than the devaluation of their property.

Ten out of the fourteen standard lease applications that followed an LPA or experimental lease had no public comments. Whereas the two stand alone standard applications both had a long list of interveners. The reduction in public comments on standard leases that followed an experimental lease or LPA reflects the successful mitigation of stakeholder concerns. In addition, riparian owners became accustomed to the aquaculture operation and discovered how little it affected their use of the coast. In multiple public hearings, riparian owners testified on behalf of the aquaculture operator. However, in one case, three riparian owners complained about the same aquaculture farm and its proposal to expand by claiming they weren't given sufficient notification about the process. They also expressed grievances with how the operator maintained his lease site given his two violations of lease conditions.

#### *4.5 Economic Impact*





The last complete recorded harvest was \$1,754,744 for oysters alone. The peak oyster harvest was in 2008 with \$2,024,575 in direct revenue.<sup>76</sup> Blue mussel harvest was \$782,642 in 2012 with a peak of \$1,177,738 in 2009. Finfish harvest is responsible for approximately two thirds of the \$82 million in direct revenue generated by aquaculture. Total aquaculture activity creates \$130 million in total economic activity in Maine on an annual basis. The industry generates \$97 million in tax payments annually.<sup>77</sup> Citizens directly or indirectly employed by the industry earn a salary of \$156,000; double the average salary in Maine. Sixteen active Maine mussel lease sites employ over 55 full time workers while the 26 standard oyster leases employ nineteen full time workers and 55 seasonal employees.<sup>78</sup>

One major source of economic loss is shellfish closures due to impaired water quality. In 2005, the month long red tide closures caused a \$6.0 million decrease in direct revenue and an overall economic impact of \$14.8 million.<sup>79</sup>

The impact of regulations on a microeconomic scale is best seen through meeting minutes of the Aquaculture Advisory Council (AAC), made up of industry representatives. A few problems they mention include the length of the standard lease. The short duration and renewal uncertainty makes investors weary. Aquaculture industry representatives opposed the public's ability to comment during the renewal, which they claim occur even when the leaseholder has been compliant. Other critiques included the overvaluation of eelgrass and the irrelevance of mitigation efforts.<sup>80</sup> AAC requested more flexibility in gear changes to better adapt to technological improvements. One industry leader requested the DMR be more specific on what gear changes require a variance application. In addition, the council requested the DMR allocate more funds to the permitting process to speed up the application processing time.<sup>81</sup>

The AAC included requests that the Department of Economic and Community development address misconceptions about aquaculture through consumer education and guidance in communicating with the riparian owner.<sup>82</sup>

#### *4.6 Environmental Impact*

Shellfish aquaculture's environmental impact pales in comparison to the enormous environmental impact of finfish operations. Therefore, DMR scarcely researches the ecosystem effects of marine shellfish aquaculture in Maine. There are a few DMR studies that shed light on potential issues.<sup>83</sup>

In 2003, the DMR researched the effect of marine shellfish aquaculture on the benthic environment below rafts. Multiple sites had a four-inch thick layer of organic material and shells under the suspended culture rafts. This organic layer created a dead zone in two aquaculture sites out of the six tested. At other aquaculture sites, the build up of organic material did not seem to change the dissolved oxygen or impair ecosystem functions. Multiple species such as crabs and sea stars were found in the site.<sup>84</sup>





Sulfides, ammonium, chlorophyll, and nutrient pollution were identified under bottom culture and suspended culture farms. The nutrient pollution changed the fauna below the mussel rafts to smaller more opportunistic species thus reducing the diversity of the ecosystem.<sup>85</sup> Sediment variety also decreased under the rafts. These conditions make the benthic environment less hospitable, however the overall impact on the ecosystem is very small because DMR does not approve leases on sensitive environments. They also found that the area under the aquaculture pen quickly recovers once the organic material is removed.<sup>86</sup>

An externality of shellfish aquaculture is the removal of phytoplankton. In large operations, the population of aquaculture shellfish competes with native biological communities for food. In Maine this has not been identified as a problem due to the limits on size, number of species harvested, and distance between aquaculture lease sites.<sup>87</sup>

There is no evidence of cultured species becoming invasive in Maine. Introduced species such as the Northern quahog and English mussel have not impacted native species since their harvest.<sup>88</sup> However, some fishermen asserted that mussel aquaculture reduces the scallop populations. Wild species such as waterfowl, eagles, and seals' proximity to human activity, predator nets, lights, and noise concern environmentalists.<sup>89</sup> Lack of extensive research makes it difficult to say the degree to which aquaculture affects these wild communities.

Environmentalists also critique DMR's environmental inspections and monitoring.<sup>90</sup> The agency's environmental impact analysis is cursory at best when compared to the environmental impact statements required for similar sized projects located on land. These environmentalists also compare the stringency of shore land zoning to what they believe is a lenient public trust leasing process.<sup>91</sup>

## **5. CONCLUSION**

It is clear that each state holds very different philosophies regarding the regulation of its aquaculture industry, offering unique insight into potential advantageous solutions that can be employed in New Hampshire. Massachusetts' approach towards aquaculture regulation is best stated as "home rule": the ability of each municipality to develop town-specific requirements on top of a broader, existing framework of state requirements. While the Division of Marine Fisheries has the final say in the permitting process, it is the towns themselves—through a combination of efforts by the shellfish constable, the conservation commission, and the Board of Selectmen—that facilitate the permitting process and mediate any public trust issues before they rise to the state level. Such a system allows for each municipality to create regulations which best serve its individual needs and eliminate potentially redundant or unnecessary statewide policy. In this way, Massachusetts differs significantly from New Jersey and Maine, which are largely governed by state agencies. Yet, Massachusetts' system struggles to standardize



its stringency and municipal enforcement due to uncontrollable variables such as understaffing or the availability of a volunteer corps. Lack of standardization makes it easier for individuals or organizations to receive a permit in some local areas than others. The largest problem, however, is a lack of inter-municipal communication, often leading to constraints when attempting to develop more efficient and environmentally-friendly aquaculture regulations.

New Jersey's approach appoints the NJDEP as the agency in charge of overseeing the process of acquiring various aquaculture licenses, and works with other state agencies in order to obtain any required secondary permits. Those who wish to establish aquaculture operations in New Jersey must follow a strict permitting process that in some cases may take over a year to complete. Because New Jersey may involve up to nine different agencies when approving a proposal, the regulatory framework can become extremely confusing and time-consuming for the applicant, and some permits may be seen as redundant or unnecessary. As a result, some aquaculturists will lay down their equipment in the water before their applications have been fully approved, although generally New Jersey has very few issues of squatters within their current system. The state as a whole is currently reviewing their aquaculture policies and making changes to combat these issues, including the creation of their new lot-based Aquaculture Development Zones. ADZs eliminate the regulatory headache for applicants, as they are preapproved and permitted by the state, and subleased to the aquaculturist. While they represent a fairly small portion of New Jersey's fishable waters, such a design may be attractive to New Hampshire, which claims a much smaller area of marine waters that could be easily divided into plots.

Of all three states, Maine represents the one which is most unified in its regulatory agencies and infrastructure. Almost all large-scale operations in Maine are approved by the Department of Marine Resources (DMR). The state's aquaculture regulations allow for the growth of the industry as well as the protection of public trust lands. Public comment periods and active conversations with landowners avoid most riparian landowner and recreational concerns. Maine avoids New Hampshire's squatting issue by allowing illegal oysters to be poached and having the coast guard constantly survey the area. Maine also provides a tiered leasing system which streamlines the process for anyone wishing to transition from smaller operations to larger ones, a notable advantage over Massachusetts and New Jersey, which are not readily scalable for size. The largest problem that Maine faces is an uncertainty about the environmental effects of shellfish aquaculture. The results of future studies may impact or change the current status of Maine's regulatory framework.



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