Supporting Municipal Co-Management of Shellfish and Community Engagement in Casco Bay, Maine

Completed in Collaboration with The Casco Bay Regional Shellfish Working Group

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EXECUTIVE SUMMARY

Shifts in the Gulf of Maine's ecosystem and food web have been observed as a result of the unprecedented warming that is occurring because of climate change. The impacts of these changes are not solely felt by marine species forcing shellfish harvesters to adapt to changes in soft-shell clam and quahog populations. Recently, harvesters have increased the amount of quahogs harvested in addition to soft-shell clams. To keep up with these changes in commercial shellfish harvests, the management of bivalve species in Maine has to be modified to ensure a thriving fishery in the future.

In Maine, shellfish that exist in the intertidal zone are co-managed between the state and municipalities. The Maine Department of Marine Resources is responsible for shoreline point-source pollution surveying, water quality testing, as well as the opening and closing of flats. Municipalities are mainly responsible for creating ordinances and determining license quotas. Recently, municipalities have been adding species to their ordinances due to an increased demand for certain species and to protect the full range of species within their intertidal zone. Managing the shellfish fishery within the Gulf of Maine is difficult for a number of reasons including limited resources, challenges associated with co-management of multiple species, challenges with the implementation of conservation practices, and the rapid changes occurring within the ecosystem.

In this report we have outlined the practices of four other states who actively manage multiple species of shellfish including Maryland, Massachusetts, Rhode Island, and Washington to better inform co-management practices in Casco Bay, ME. By speaking with scientists and fisheries managers in Maryland, Massachusetts, and Rhode Island we were able to gather information in five broad categories (conservation, monitoring, reporting, licensing, and surveying). We took a case study approach when gathering information in Washington state because the fishery differs greatly from those on the east coast. Based on the information collected and best practices in other states, we generated a list of ideas moving forward that hopefully can be used to inform co-management in Casco Bay.

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1. INTRODUCTION

Over the past 50 years, shellfish production has increased around the world. In 2003, the worldwide shellfish industry produced 13.2 million tonnes compared to the one million tonnes of shellfish produced in 1953 (Dumbauld et al., 2009). Globally, shellfish are a reliable source of protein for many communities, and provide important ecosystem services, such as water filtration and protection of shorelines from erosion (Brumbaugh et al., 2005). Shellfish are also used in cultural traditions that reflect many communities' beliefs and values (Defeo et al., 2016; Brumbaugh et al., 2005). Despite the benefits that shellfish provide, the United States did not begin harvesting shellfish until the late 1800s, far later than many other countries (Dumbauld et al., 2009). Although shellfish production has been increasing, shellfish populations have been declining due to commercial overexploitation and environmental changes such as habitat destruction through dredging and declining water quality (anoxia, harmful algal blooms) (Brumbaugh et al., 2005). In order to ensure that the shellfish industry continues to thrive, finding a successful way to manage dynamic populations is vital. By implementing feasible shellfish management practices, shellfish populations can not only be conserved for the future, but the many ecological and socioeconomic benefits that they contribute can also be protected (Brumbaugh et al., 2005).

One such practice to ensure sustainable use of shellfish is co-management (Co-M). Co-M addresses the issue of overexploitation of common pool resources (i.e., shellfish), and has been implemented worldwide (Gutiérrez et al., 2011). By engaging people using a given resource, management institutions can give them a greater stake in its long-term success and sustainability, encouraging them to follow the rules they helped to create (Ostrom, 2009). Unlike top-down management systems, Co-M calls for cooperative management, in which the resource users (ie. shellfish harvesters) are involved in decision-making processes alongside upper management governing bodies (Defeo et al., 2016). The sharing of responsibility among actors and institutions in this manner can lead to a more resilient resource system by allowing for the inclusion of many types of knowledge in management decisions. When implemented from the bottom-up, Co-M systems acknowledge the expertise and experience of people actually working with the given resource, while also including governmental and scientific knowledge from other stakeholders (McGreavy et al., 2018). Co-M systems may vary across regions, as they are designed specifically with the unique environmental context and socioeconomic climate of a fishery in mind (Defeo et al., 2016).

In Maine soft-shell clam and quahog fisheries provide a livelihood to thousands of Maine residents. Clamming is also an important cultural practice to Mainers, passed on from generation to generation ("About clamming," n.d.). Along the Maine coast, clam fisheries are co-managed by individual towns in conjunction with the state Department of Marine Resources (DMR). Co-M of shellfish in Maine works to create an industry that can quickly adapt to environmental threats such as ocean acidification and invasive species. By including government officials,

scientists, fishermen, and conservation experts, current Co-M systems are working to address economic issues such as the decline in state license sales, price fluctuations, and the changing age demographic of the shellfish industry here in Maine (McGreavy et al., 2018). The continued collaboration between the many actors involved in Co-M of shellfish is crucial to improve restoration outcomes into the future (McClenachan et al., 2015).

In this project, we looked closely at the soft-shell clam and quahog fisheries in Maine, and took a place-based approach in our study of the Casco Bay area. Though Co-M systems generally are effective in promoting linear communication from the harvester, to the municipality, to the DMR, communication between municipalities is limited in some regions. In particular, the ten towns that harvest in Casco Bay have had limited communication on shared management and conservation techniques in the past. In order to increase inter-town communications, the Casco Bay Regional Shellfish Working Group (CBRSWG) was created in 2019 with the goal of organizing stakeholders together to facilitate better Co-M (Olcott, 2019). The CBRSWG has explored management practices that municipalities have in place to balance the management of multiple species, including various options for licensing, surveying and conservation activities. To achieve these goals, the working group wants to examine the best management practices being done in other states. In partnership with the CBRSWG, we generated a report of the methods Massachusetts, Maryland, Rhode Island, and Washington have implemented to monitor, license, conserve, survey, and report multiple clam species, in order to inform future practices for the soft-shell and quahog fisheries of Casco Bay.

Aim

To provide resources for successful co-management of multiple species of shellfish in the Casco Bay region to ensure a thriving fishery and healthy marine ecosystem in the future.

Objective

Identify, organize, and synthesize existing information on the management of clam fisheries in Maryland, Washington, Rhode Island, and Massachusetts. This will inform decision-making for municipalities already managing multiple species of shellfish in ordinances or considering adding species.

2. METHODS

In order to achieve the above objective, we followed the methodologies below:

1. **Conduct literature review**
   Examining existing research and information was vital to achieving our deliverable. In order to find necessary information for our deliverable, we explored state websites and academic papers on Co-M.

2. **Interviews**
   For this step we researched the state equivalents of the Maine DMR for Massachusetts, Rhode Island, Maryland, and Washington, and interviewed two- to three- key people from each state. We drafted approximately 20 interview questions, addressing the conservation practices, license allocation, survey methods for multiple species, governance system, health monitoring, and reporting/assessment for our key people from each state. Our community partners revised and approved these questions before we began conducting interviews. We interviewed each person, and recorded their interview, after gaining consent from the interviewee, to make transcription easier. For each interview we transcribed all data from audio recordings, and compiled the necessary data into our shared Google Drive.

3. **Analyze interviews and literature review for states**
   We conducted a qualitative analysis of all interview data. We coded interviews using unique codes for each of the five categories (conservation, licensing, surveying, reporting, monitoring, and also coded for governance style. Because Washington's shellfishery is so different from the other three states, we took a case study approach in our analysis and did not follow the same coding system as we did for the other three states. Interviews were conducted to better understand how tribal co-management is utilized and implemented in Washington state.

Deliverable
A comprehensive inventory of methods being used to monitor, license, conserve, survey, and report multiple species at the local, tribal, and state level. By specifically examining Massachusetts, Rhode Island, Maryland, and Washington, the report summarizes potential applications of these findings in Maine.

3. RESULTS AND DISCUSSION

3.1 Governance

Though the CBRSWG did not specifically request a review of best governance practices in other states, this section will provide context into the shellfish management systems of each state. Being familiar with this context will facilitate better understanding of the practices in the following five categories.

Massachusetts

In Massachusetts, the state's Division of Marine Fisheries (DMF) works closely with towns to manage all fisheries. The DMF designates areas as one of five conditions: approved, conditionally approved, restricted, conditionally restricted, and prohibited. Because the state practices Co-M and operates under home rule, local municipalities are responsible for managing their approved harvesting areas. In these areas, towns have the authority to establish aquaculture with input and permits from the DMF, and to close areas for shellfish propagation. When the DMF opens a conditionally approved area, the town then has the same authority to manage it like they would with an approved area. Summing up the concept of home rule, an interviewee from the DMF informed us that the state "deal[s] with the towns one-on-one all the time, they're our partners in this… we rely on them and they rely on us" (Massachusetts 2, 2020).

An example of how the home rule system functions can be found in Barnstable, MA, a coastal town on Cape Cod. Soft-shells and quahogs are managed through a nine seat shellfish advisory committee, made up of commercial harvesters, aquaculturists, and recreational harvesters. The committee comes together to discuss new ideas for the fishery, which are then vetted through town government before approval. Municipalities support the home rule management system because it accounts for Massachusetts' dynamic coastline and species variance (Massachusetts 1, 2020).

Rhode Island

The shellfishery in Rhode Island is unique in the sense that the management of shellfish resources was written into the state constitution, allowing the Department of Environmental Management (DEM) within the state to have ultimate authority (Rhode Island 2, 2020). One exception to this exists in Block Island, a town that has a little more leeway in how they are allowed to manage their resources. However, even in this town, the ultimate industry authority lies with the DEM (Rhode Island 3, 2020). Yet, the individuals from the DEM work collaboratively with towns and harvesters to ensure decisions are made effectively. Specifically, within the DEM there is a group titled the Shellfish Advisory, composed of appointed shellfish harvesters, which allows harvesters to have a say in the creation and modification of regulations

within the industry. In order to ensure that regulations and modifications within the industry are created fairly, all new regulations or modifications need to be passed by the panel. When asked about strengths of collaborative decision making between the state and wild harvesters, an interviewee from the Rhode Island DEM mentioned "buy-in from the beginning and being realistic and pragmatic in creating policies." When the same person was asked about the disadvantages to managing in such a collaborative way, they stated the intensive amount of time involved in creating and modifying regulations. Furthermore, when asked about challenges to managing shellfisheries in a collaborative manner, the interviewee mentioned that "an object entity, that's trusted by both sides adds value to this process because when there is conflict someone can mediate it" (Rhode Island 1, 2020).

Maryland

The regulations and laws for the shellfishery in Maryland are ultimately created by the state's Department of Natural Resources (DNR) and the Maryland general assembly. In order to ensure that other stakeholders are represented, the general assembly holds hearings where anyone can speak about the proposed bills (Maryland 1, 2020). Additionally, because oysters are an important product in Maryland, an Oyster Advisory board exists to ensure that harvesters are being heard. This board consists of 5-15 members from 10 or 11 counties in Maryland. These individuals work in conjunction with the state DNR to manage and ensure maximum efficiency of the oyster fishery. Although no official advisory boards exist for clam species, harvesters have begun to self-organize themselves into committees and the state DNR will work with them to manage clam resources. When asked about strengths of collaboration between the state and wild harvesters, an interviewee mentioned "stakeholder involvement, buy in, and harvesters as part of the decision making process." When the same individual was asked about disadvantages of managing shellfisheries collaboratively between the state and wild harvesters, the informant mentioned that "decisions can take longer and processes get bogged down" (Personal Communication, 2020). However, it is important to note that this informant clearly stated that these disadvantages do not bother the DNR.

3.2 Conservation

	Conservation Projects	**Harvester Participation Requirements**
Massachusetts	Relay of clams from conditionally restricted and restricted areas[1] (by	None

[1] National Shellfish Sanitation Program (NSSP) Guide for the Control of Molluscan Shellfish (2017): Ch 5.01 https://www.fda.gov/media/117080/download

	individual towns & state)	
Rhode Island	Shellfish Management Areas and relaying of clams	None
Maryland	No conservation projects	None

Table 1. Current conservation projects and participation requirements in the clam fisheries in Massachusetts, Rhode Island, and Maryland.

Massachusetts

In Massachusetts, the senior shellfish biologist of the DMF oversees the relay of clams from contaminated areas throughout the state, which they informally refer to as 'contaminated relays'. This process involves contracting dredge boats to harvest quahogs out of restricted areas, and plant them in conditionally approved and approved areas. The quahogs are left for at least three months to clean themselves and spawn, and are monitored for health and stock numbers before the area is reopened for commercial and recreational harvesting.[2] Individual municipalities may also choose to conduct contaminated in-town relays on a smaller scale, moving stock from conditionally restricted and restricted areas to conditionally approved or approved areas to give shellfish a chance to clean themselves and supplement population numbers. Individual municipalities may also do propagation work, with DMF permitting, in which they purchase seed from a hatchery and raise it in an upweller before transferring stock into the public beds. Unlike Maine, there are no participation requirements for conservation projects in order for harvesters to keep a license, all participation is voluntary (Massachusetts 2, 2020).

Box 1. In-Town Relay of Clams from Contaminated Areas in Westport, MA

In Westport, a coastal town in southeastern Massachusetts, the town conducts yearly contaminated relay projects to ensure healthy and numerous quahog populations. Contaminated relays help towns keep their harvesting areas open by replenishing their stock, while also improving the health of shellfish by relocating them to cleaner waters. While the number of bushels and relocation areas can vary, Westport relays approximately 3,000 bushels (one bushel is roughly 60 lbs.) of quahogs per year from the Taunton River into five different harvesting locations. Once the quahogs are relocated, they are given at least three months to clean themselves and reproduce, and are tested for fecal coliform before each area is opened. Once an area is opened, harvesters are careful not to harvest quahogs too quickly to avoid flooding the market. To keep the market price stable, they designate certain harvesting days to each area, allowing shellfish to continue to grow and depurate on the off-days (Massachusetts 2, 2020). This example shows how conducting contaminated relays on a small scale can benefit local harvesters, as long as they manage the increased stock carefully and sustainably.

[2] For more information, please contact Gregory Sawyer, Massachusetts Senior Area Biologist at gregory.sawyer@state.ma.us.

Rhode Island

In Rhode Island, two important conservation projects are currently taking place. The first is the creation of Shellfish Management Areas, sanctuaries that allow broodstock to remain in place and for more restrictive regulations to be imposed. The second conservation project is the re-laying of clams into these designated Shellfish Management Areas, which allows for increased broodstock and recruitment for future harvest. The state of Rhode Island itself puts very few resources directly into the conservation of shellfisheries and therefore it is necessary for the DEM to find other sources of revenue to fund these important projects. Specifically, the shellfish industry in Rhode Island uses part of the money collected from commercial fishing license receipts (which is held in a restrictive account that only the DEM can access) to enhance these conservation projects (Rhode Island 1, 2020; Rhode Island 2, 2020). Harvesters in Rhode Island are not required to volunteer hours for these conservation projects but they can get paid to help move clams for relays. For example, if a harvester fills a peat bag full of clams to the label on the bag (around 50 pounds) they will receive a credit that allows them to get paid for their work (Rhode Island 1, 2020).[3]

Maryland

In Maryland, a few conservation projects exist for oyster species as these are the most profitable shellfish in the area. Some of these conservation projects include restoration money, tightened regulations, closing areas for a determined amount of time, and a sanctuary program to protect and enhance future broodstock (Maryland 2, 2020). There are no requirements for harvesters to volunteer hours for these oyster conservation projects. No clam conservation projects are currently going on in the state (Maryland 1, 2020).

3.3 Monitoring

	Monitoring
Massachusetts	Shellfish safety: Division of Marine Fisheries Rainfall monitoring: Towns
Rhode Island	Shellfish safety: Department of Health
Maryland	Shellfish safety: State Water Quality Unit

Table 2: Monitoring protocols for Massachusetts, Rhode Island, and Maryland.

[3] For more information, please contact Dennis Erkan, Rhode Island DEM at dennis.erkan@dem.ri.gov.

Massachusetts

In Massachusetts, the DMF faces staff shortages. According to an interviewee from Barnstable, the DMF is working on doing enough water quality sampling just to meet the requirements to keep areas open for harvesting (Massachusetts 1, 2020). The state tests for fecal coliform, as well as harmful algal blooms including red tide, amnesic shellfish poisoning, and diuretic shellfish poisoning. Additionally, each municipality has a memorandum of understanding (MOU) with the DMF to monitor rainfall levels in conditionally approved areas based on rainfall to determine when to close their areas for a pollution event. The MOU establishes the amount of rainfall necessary to close an area. For example, if a town has more than 0.3 inches of rain in a 24-hour period, they must close the affected area for five days to allow the shellfish to depurate and recover from any pollution event caused by runoff into the water body (Massachusetts 2, 2020). Each municipality does this monitoring for themselves, following the same protocol set by their MOU (Massachusetts 1, 2020; Massachusetts 2, 2020).

Box 2: Water Quality Monitoring in Swansea, MA

One example of how monitoring can help harvesters came up in an interview with a shellfish biologist from Massachusetts. He explained that the town of Swansea's shellfishery had been closed for approximately 25 years, and in 2006 the town was looking to reopen their areas. They contacted the DMF to set up a sampling program, where DMF biologists monitored pollution levels during the different seasons and varying amounts of rainfall. When they got the data back, they found that sometimes during rainfall, pollution counts were elevated, but during dry weather they met all of the National Shellfish Sanitation Program's (NSSP) criteria for harvesting. DMF determined through data collection that after three days, the pollution event subsided, and after five days the shellfish had successfully depurated. After 2.5 years of data collection and analysis, the state reopened Swansea's shellfishery as conditionally approved, based on rainfall. Many towns in Massachusetts who have conditionally approved areas based on rainfall now read their gauge every morning, and whenever their rainfall levels exceed the allowable amount in a 24 hour period, they close their shellfishery for five days (Massachusetts 2, 2020). This example shows that increasing monitoring partnerships between towns and states can lead to positive outcomes for harvesters.

Rhode Island

In Rhode Island, the Office of Water Resources within the Department of Health is in charge of monitoring water quality, temperature, and taking other necessary measurements throughout the state. Within the Office of Water Resources, a shellfish monitoring program exists in which individuals are specifically tasked with ensuring that shellfish areas are healthy (Rhode Island 3, 2020). Not only does this program take the necessary measurements, they also make regulations for how quickly quahogs need to be chilled after harvest and how much time must pass before the quahogs can be marketed (Rhode Island 2, 2020).

Maryland

In Maryland, fixed stations exist where individuals from any department, but mostly from the water quality department, can go and take water samples to measure for temperature, salinity, and dissolved oxygen. The water quality department collects water samples from these stations throughout Rhode Island on a monthly and sometimes bi-monthly basis (Maryland 1, 2020). Additionally, there are 51 oyster sanctuaries total that are monitored by the Department of Natural Resources, however five of these sanctuaries receive targeted investment. Targeted investment in these five sanctuaries means that after three years, individuals from the DNR check on how things are going and observe oyster survival rates. Furthermore, after an additional three years, completed in the sixth year, another check is done to observe the same things as in year three. Monitoring of the other 46 sanctuaries is done "at some point," but not every year. Clams, specifically, are only monitored if there is a large die-off, or if someone applies to lease the bottom (Personal Communication, 2020).

3.4 Reporting

	Frequency	**Who Reports**	**Type of Data**
Massachusetts	Annual for harvesters, weekly for dealers	Harvesters and dealers	Number of bushels and location (harvesters), number of bushels per species and price (dealers)
Rhode Island	Every 2 weeks	Dealers	Landings in electronic database
Maryland	Weekly for harvesters, monthly for dealers	Harvesters and dealers	Location and date per bushel (harvesters), location, number of bushels, and sales (dealers)

Table 3: Measures of reporting harvest data for Massachusetts, Rhode Island, and Maryland.

Massachusetts

In Massachusetts, harvesters report annually to the DMF's Boston office. Information on the number and location of bushels harvested is entered into a database to keep track of stock and landings information. Each town reports their amounts of recreational harvesting to the DMF as well. Dealers report weekly on the number of bushels purchased per species, and the price they were purchased at (Massachusetts 2, 2020).

Rhode Island

Reporting in Rhode Island is interesting in the sense that if the harvester only fishes shellfish, there are no reporting requirements. However, if the harvester fishes shellfish along with some other organism, for example finfish, the harvester must report everything to the DEM via paper or through an electronic system (Rhode Island 3, 2020). In order for harvesters to sell their catch, they must sell to a licensed dealer, preventing them from selling their catch themselves. When catching shellfish, harvesters are required to tag each bushel of shellfish with its location using a tagging area map. Additionally, when selling catch to a shellfish dealer, harvesters will swipe their licenses and data on whatever is sold to the dealer will go into a database called the Standard Atlantic Fisheries Information System (SAFIS), when the dealer reports to the DEM twice per week. Therefore, what it ultimately comes down to is that harvesters cannot sell their catch if they do not report it (Rhode Island 2, 2020).

Maryland

In Maryland, harvesters are required to tag each of the bushels they catch with location and date and report this information to the DNR weekly. Additionally, shellfish dealers have to report to the DNR monthly on the harvested location of the bushels they bought, the number of bushels bought, and total sales. It is required that shellfish dealers obtain the signature of the harvesters from which they buy their shellfish. Furthermore, shellfish dealers are responsible for paying the per bushel tax for each species requested by the DNR (Personal Communication, 2020).

3.5 Licensing

	License Type	**Endorsements Required**
Massachusetts	Commercial Master Permit	No per-species endorsements are required
Rhode Island	Multipurpose, Principal Effort, Commercial Fishing	Required under principal effort and commercial fishing licenses, but not for multipurpose licenses
Maryland	Tidal Fish License	Yes, harvesters must obtain per-species endorsements in order to harvest

Table 4: Multiple species licensing protocol for Massachusetts, Rhode Island, and Maryland.

Massachusetts

Following the home rule policy, licensing in Massachusetts varies town by town. Most towns in the state offer master permits for commercial harvesters that cover all shellfish species in that town. In the case of Barnstable, they offered per-species licenses until 2000, after which they switched to a master permit but with more restrictive numbers. Prior to this switch, 200 commercial harvesters were licensed, which led to severe overfishing of soft-shell clams. Offering fewer licenses but including all species under one license helped restore soft-shell populations, and helped Barnstable reach a sustainable total of 47 licensed harvesters (Massachusetts 1, 2020).

Box 3: Multiple Species Licenses in Barnstable, MA

In the 90s, the town of Barnstable offered separate licenses for different species, and had over 200 harvesters in their soft-shell and quahog fisheries. By 2000, this system led to severe overfishing of the soft-shells in Barnstable Harbor, and the shellfish advisory committee decided to do a total overhaul of their licensing system, in conjunction with the town council. They altered their ordinance to state that they would not issue new licenses when someone does not renew their license, to slowly lower the number of licensed harvesters. They also chose to eliminate per-species licenses, and offer a master license instead. Over time, these two changes led Barnstable to arrive at 47 total commercial licenses, which is still the number they have today. The soft-shells have rebounded, and the new license limit has made their fishery more sustainable, ensuring a healthy ecological and economic future (Massachusetts 1, 2020).

Rhode Island

Five different types of licenses are available in the state of Rhode Island. First is the Multipurpose license which can only be obtained via renewal for $300, meaning that no new Multipurpose licenses are issued. Furthermore, anyone holding a Multipurpose license can fish legally harvestable species at full effort (12 bushels a day) and does not need to obtain any further species endorsements. The second type of license is the Principal Effort license which allows license holders to fish legally harvestable species at full effort. However, this license differs from the Multipurpose license because individuals holding a Principal Effort license are required to obtain endorsements for the species or group of species that they wish to fish. Four different endorsements exist for this license, including quahog, soft-shell, whelk, and other shellfish. The cost of this license is $150 (including the first endorsement) and $75 for each additional endorsement. The third type of license is the Commercial Fishing license which allows license holders to fish soft-shells, whelk, and other shellfish at full effort, assuming that they hold the endorsements required. The endorsements for this license are the same as the endorsements for the Principal Effort license. This license differs from the two stated above because license holders may only harvest 3 bushels of quahogs per day. The cost of this license is $50 and $25 for each endorsement. After actively fishing on this license for two years, individuals can apply for a Principal Effort license, but obtaining this license is based on the

entry/exit ratio of each endorsement. Currently, two Multipurpose or Principal Effort licenses must be retired before a Commercial Fishing license with a quahog endorsement can be issued. The required number of Multipurpose or Principal Effort licenses that must be retired frequently changes based on the Advisory Panel's decision. Additionally, it is important to note that five licenses- Multipurpose, Principal Effort, or Commercial Fishing- must be retired before a new commercial fishing license with a soft-shell endorsement can be issued. Furthermore, if a harvester would like a whelk endorsement, the harvester must first obtain a commercial fishing license with a quahog or soft-shell endorsement. The fourth type of license is the Student Fishing license, which is available to any full time student under the age of 23. This license allows the student to harvest 3 bushels per day, and costs $50. The fifth and final type of license is the Over 65 license, which allows license holders to harvest 3 bushels per day. This type of license is free, but license holders may only harvest quahogs (Rhode Island Shellfish Management Plan, 2014).

Maryland

The first step to shellfishing in Maryland is obtaining an all-inclusive Tidal Fish License (TFL), which allows license holders to fish anything, including crabs, fish, oysters, eels, etc. After obtaining a TFL, additional surcharges need to be paid in order to fish specific species. However, there is a set number of TFLs that can be given out, therefore if all TFLs are given out, an individual will need to wait for someone to retire or pass away for a license to become available (Personal Communication, 2020). With regards to species-specific licenses, there is no restricted or limited entry for any of the shellfish. It is important to note that for clams in particular, fishing for soft-shell and razor clams is covered under a single license, while quahogs are covered under an entirely separate species-specific license (Maryland 1, 2020). In order to keep a TFL, harvesters need to renew their licenses every year by the deadline, pay any species-specific surcharges, call in and call out when fishing in some fisheries, and pay per-bushel taxes on both oyster and clam species (Personal Communication, 2020).

3.6 Surveying

	Survey Type	**Frequency**	**Standard Protocol?**
Massachusetts	Systematic biological sampling along transect	Case-by-case basis, before a dredge or pier project	Yes, towns follow state's protocol
Rhode Island	Suction sampling and dredge survey	Annual	Yes, done by state
Maryland	Dredge survey	Annual	Yes, done by state

Table 5: Shellfish survey frequency and type for Massachusetts, Rhode Island, and Maryland.

Massachusetts

In Massachusetts, harvesters do not conduct stock number surveys. When a survey is conducted, DMF shellfish biologists, and sometimes shellfish biologists belonging to each individual municipality (Massachusetts 2, 2020). Surveys happen on a case by case basis, typically either prior to a significant dredge or pier project, or a new report of high shellfish numbers in a particular area (Massachusetts 1, 2020; Massachusetts 2, 2020). When an area is reported to have increased population numbers, the town's shellfish biologist may conduct a survey following a systematic biological sampling protocol set by the state to determine whether or not to increase commercial harvester access to the given area (Massachusetts 1, 2020).

Rhode Island

The state of Rhode Island conducts two surveys. The first survey is titled the suction sampling survey in which an individual from the DEM randomly places square-meter quadrats and uses the suction sampler to excavate everything within the quadrat. After everything within the quadrant is brought up, all organisms- from small to legal size- are measured and quantified. The sites for this survey are on rotation, meaning that although the survey is conducted every year, not every site is surveyed every year. The second survey conducted is a dredge survey, focused mainly on Shellfish Management Areas, in which a small hydraulic dredge is towed 100 feet. Everything that is brought up in the dredge is measured for abundance, density, and size. Similar to the suction survey, sites for this survey are on rotation. However, some areas are surveyed every year, and at least 50% of all the sites in Rhode Island are surveyed each year (Rhode Island 1, 2020; Rhode Island 2, 2020).

Maryland

Maryland strives to perform a Coastal Bay survey annually, however at times it is not possible due to a lack of funding. For this survey, bays are stratified and a designated number of samples are taken at random within each section (almost 300 stations are visited each year). At each location a hydraulic escalator dredge is towed 250 feet, and all shellfish species are collected and measured for size and abundance. Additionally, at some of the stations, samples of oysters are brought back to the lab for disease testing to allow for an overall estimate of shellfish health in the specified location (Maryland 1, 2020; Personal Communication, 2020).

3.7 Washington State Shellfish Management Case Study

History of Tribal Co-management in the state of Washington

Prior to the arrival of European explorers in 1805-06, Washington's fisheries were used as a prolific source of food for tribal groups who inhabited the area. Native Americans maintained control of the fishery through the Civil War period despite the widespread settlement that was happening in the area. During this time, salmon populations were abundant in the Pacific

Northwest waters (Parker, Rucker, & Nickerson, 2016). In 1855, the United States agreed to purchase land from native groups in exchange for money and access to the fishery ("Historical background," n.d.). The canning process allowed for the creation of a commercial fishery because salmon could be preserved and shipped (Parker et al., 2016).

As the salmon industry grew through the 19th century into the 20th, Native Americans found their treaty-protected rights under threat (Parker et al., 2016). By the 1960s into the 1970s, a time period referred to as the Fish Wars, tribes struggled to have their rights to the fisheries recognized, and tribal members were arrested and jailed for violating state law (Figure 1) ("Historical background," n.d.). The conflict between Washington state and the treaty tribes garnered national attention through protests and tribal support from celebrities, eventually resulting in intervention by the United States federal government (Kamb, 2004). Eventually the United States sued the State of Washington on the grounds that they had failed to uphold the treaty agreements signed in 1855 ("Historical background, n.d."). In 1974, the Boldt decision ruled in the federal government's favor and guaranteed tribal groups a 50% share of the state's fishery which was a major victory for tribal groups (Figure 1) (Tizon, 1999). The Northwest Indian Fisheries Commission (NWIFC) was established as the regulatory agency for the treaty tribes the same year. As a result of the decision, the management of the fishery was then split between NWIFC and the Washington Department of Fish and Wildlife (WDFW) marking the beginning of fisheries co-management (Parker et al., 2016).

The Boldt decision used language that gave the tribal groups access to salmon, but the state of Washington denied tribal groups an equal 50% share of shellfish (Parker et al., 2016). In 1989, the United States and 16 treaty tribes filed a Request for Determination to extend their fishery rights to shellfish. The Rafeedie decision was made in 1994 giving tribes the right to harvest shellfish (Figure 1) (Carson, 2020). Today the NWIFC and WDFW work closely together to manage shellfish, which in recent years have become extremely lucrative fisheries in Washington State.

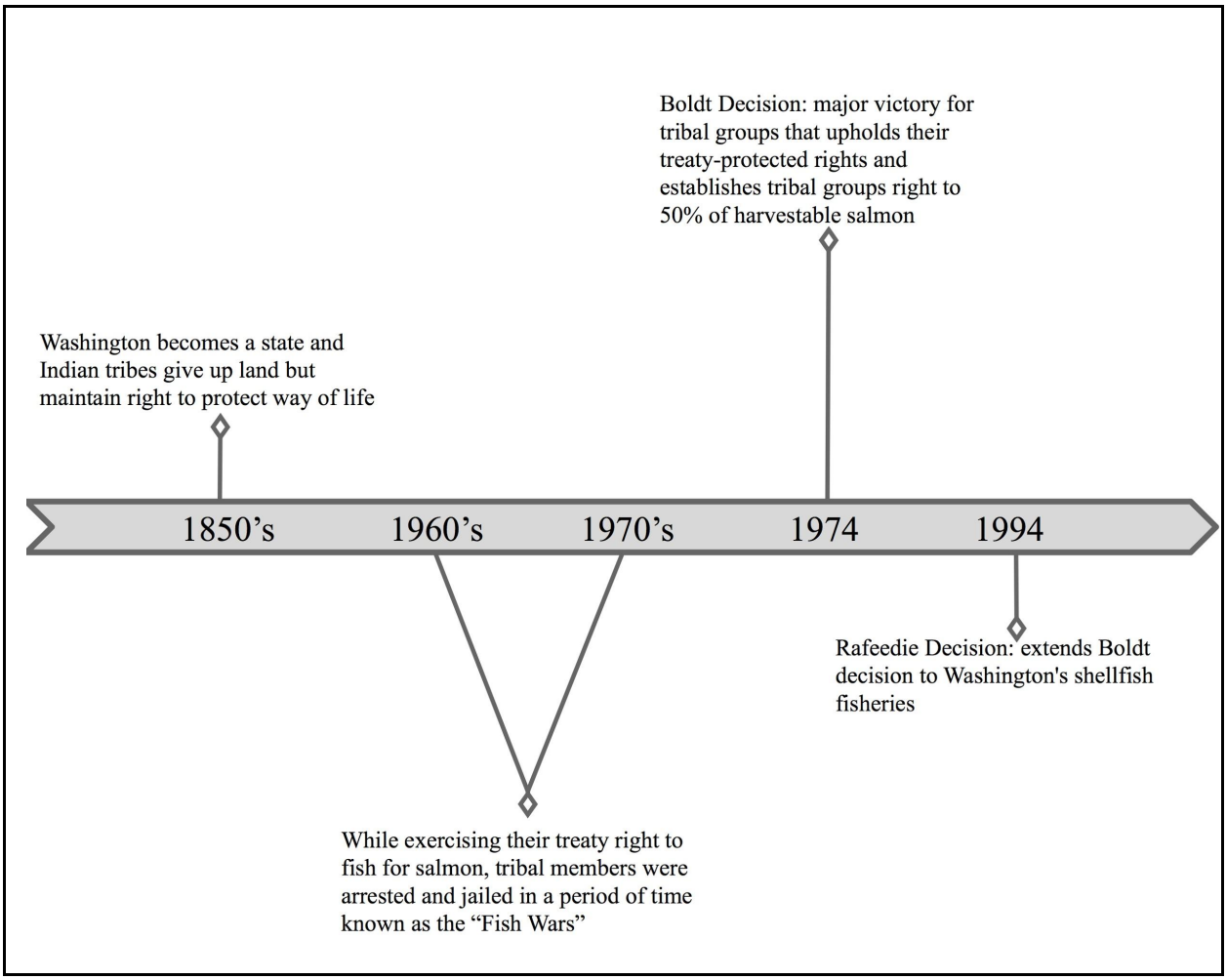

Figure 1. Timeline of fisheries management in Washington state.

Geoduck Fishery

Background

The average geoduck (*Panopea generosa*) in Washington state is 2.07 pounds and can live 160+ years, making geoducks much larger than the clam species harvested on the east coast (Carson, 2020). They are found in places with soft substrate in both subtidal and intertidal zones. In 1967, Washington State started conducting subtidal geoduck scuba surveys to get an idea of their relative abundance and distribution, and found that approximately 110 million pounds of geoduck existed in the Puget Sound (Carson, 2020). Today surveys are conducted on harvest areas known as "tracts." Divers conduct biological surveys to determine the average geoduck weight, density, and the environment in which it exists (Carson, 2020).

Co-management

The commercial geoduck fishery was established in 1970 and co-managed by the WDFW, responsible for biological management, and the Department of Natural Resources (DNR),

responsible for harvest management. The annual revenue is around $22 million USD (Carson, 2020). Since the Rafeedie decision in 1995, the state of Washington and treaty tribes share the fishery 50:50 ("Shellfish treaty rights FAQ," 2016). In 1997, state and tribal co-managers came together and decided to implement a deterministic age-structured equilibrium yield model to assess existing populations (Carson, 2020). A total allowable catch (TAC) rate of 2.7% was also set forth. When a tract is being harvested 35% of its pre-fishing biomass must remain ("Geoduck, 2020").

The state sells the rights to harvest shares of the state's quota in a competitive bid process between dealers (Carson, 2020). Geoduck dealers then hire dive teams to harvest the share of geoducks they have purchased from the state on discrete geoduck tracts (Carson, 2020). Tribal groups harvest their quotas in areas where the group historically harvested geoducks (usual and accustomed areas) (Washington 1, 2020). Tribal harvesters collect geoducks for commercial, ceremonial, and subsistence purposes ("Shellfish treaty rights FAQ," 2016). Shellfish monitors are present at every state and tribal harvest to ensure fishing regulations are being followed by all (Washington 1, 2020).

Both the state and tribal groups employ a range of scientists and managers who work together and follow the same protocols to ensure geoduck data collection is being conducted in a consistent way. Because one group is not in charge of the fishery, determining quotas, setting seasons, and monitoring has to be determined through consensus (Washington 1, 2020). The long-term protection of the resource is important to both parties, making collaboration crucial to maintaining a healthy ecosystem. Each tribal group negotiates with the state on their own behalf, so coming to decisions can be difficult as there are so many separate stakeholder groups. A scientist at the WDFW stated that it can feel like making an international decision because there are so many parties with different interests. They also mentioned that they believe that the many perspectives, though sometimes hard to balance, make the science and management better in the end. If a conflict does arise, it can be disputed in court (Washington 1, 2020).

Manila Clam and Littleneck Clam Fisheries

Background

Other than geoducks, other smaller clams are abundant on Washington's shores. Manila clams (*Venerupis philippinarum*) and native littleneck clams (*Leukoma staminea*) are two species that have been harvested both recreationally and commercially in Washington State. Manila clams grow up to 3 inches, burrow 2-6 inches into substrate, and are found in the upper-intertidal zone ("Manila clam," 2020). Native littleneck clams group up to 3.5 inches burrow 4-6 inches into substrate, and are found in the mid-intertidal zone ("Native littleneck clam," 2020).

Co-management

Like the geoduck fishery, the Manila clam and native littleneck clam fisheries are co-managed between the 15 tribal groups and the state of Washington (Personal Communication, 2020). Surveying by the state and tribal managers is done using a systematic random line transect protocol ("Clams ," 2015). About 35 out of the 131 actively managed beaches are surveyed per year. Higher priority beaches are those used for tribal commercial harvests. Once biomass assessments are completed by the state and tribal groups the data is shared. The harvest rate for the Manila clam is 33% of the standing stock and the native littleneck is 25% of the standing stock. From there, the TAC is calculated and divided between the state and tribal groups (Personal Communication, 2020).

The state has a very active recreational fishery for Manila and littleneck clams but does not have a commercial fishery. Recreational harvesters can purchase a shellfish and seaweed license, which is very popular because of its affordability (~$18/year) (Personal Communication, 2020). An interviewee from the WDFW said, “a lot of people get started there [with a shellfish and seaweed license], fall in love with foraging, then advance their skills into other fisheries” (Personal Communication, 2020). The state bases how long they can open beaches to those with recreational licenses based off of tide distribution and catchment studies from previous years (Personal Communication, 2020). Today the state reseeds Manila clams to sustain the recreational fishery, though the program used to be much larger when seed was cheaper and easier to find (Personal Communication, 2020).

The 15 treaty tribes harvest Manila and native littleneck clams for ceremonial and subsistence uses as well as for sale commercially ("Clams,"2015). For a commercial harvest, the clams are harvested at low tide, which changes depending on the time of the year. Commercial harvests are monitored to ensure that the correct amount of biomass is being removed from the beaches ("Clams," 2015). Many of the tribes also take part in reseeding beaches to ensure a healthy population of clams for future harvests. Manila clams are mainly reseeded because they can survive higher in the intertidal zone and do not burrow as deep into the substrate as native littleneck clams (Neumeyer, 2013).

4. IDEAS MOVING FORWARD

4.1 Governance

Though governance was not one of the categories the working group identified, we chose to include a summary of the governance strategies used by each state in our results section to provide context on the management of shellfish in that state. However, we chose not to make recommendations based on these findings as they were provided solely for general context.

4.2 Conservation

Ideas Moving Forward
1. Continue with conservation projects identified in past meetings by harvesters themselves
2. Expand relay of clams from conditionally restricted and restricted areas

Maine is a leader in conservation compared to other states we interviewed. Moving forward towns should continue implementing conservation projects identified collaboratively with harvesters. Based on our results, we believe that an additional step could be exploring relaying clams from polluted areas within Maine. Relaying involves the translocation of quahogs (or other shellfish) from conditionally restricted and restricted areas to areas with cleaner water, giving them at least 60 days to depurate as well as grow, according to the NSSP. [4] This type of program allows for increased broodstock and recruitment for future harvest (Table 1).

4.3 Monitoring

Ideas Moving Forward
1. Could monitoring partnerships between municipalities and the state be created or enhanced? a. Town involvement in testing can prevent closures

One step moving forward could be to identify potential monitoring partnerships that could be created between municipalities and the state. Although there are currently partnerships involving

[4] For more information and guidance, refer to Chapter 5 of the NSSP and contact the Maine DMR Area Biologist for your shellfish growing area.

monitoring rainfall and water quality, it is important to identify other areas in which monitoring and data sharing can be conducted between municipalities and the state (Table 2).

4.4 Reporting

Ideas Moving Forward
1. Discuss what types of reportable data could benefit management and conservation practices, who should be responsible for reporting that data, and how often data should be reported
2. Recording the location of bushels harvested may also help trace data back to individual towns, which could help towns better manage their resources

Both Massachusetts and Maryland require commercial harvesters to report data on number, location, and date of bushels harvested (Table 3). In Maine, the bushels harvesters sell to dealers are reported by the dealers to the state: the harvester's name and permit number, the date and time of the harvest, the harvest area, and the type and quantity of shellfish. These data are generally confidential on a town level, and thus must be aggregated with data from other dealers/towns in order to be shared publicly. If harvesters were required to report at the town level, the municipality could access and control the data.

Moving forward, the CBRSWG could discuss what types of reportable data could benefit management and conservation practices. Once that is determined, municipalities can evaluate their own practices by discussing who should be responsible for reporting that data, and how often data should be reported. We must also acknowledge that changing the reporting system already in place has both pros and cons, as it could require more time and effort from harvesters to be devoted to reporting data, which may be a hassle and interfere with their harvesting time. However, increasing reporting and sharing data between towns may help inform better management and conservation practices in Casco Bay.

4.5 Licensing

Ideas Moving Forward
1. Discuss implementing per-species endorsements similar to Rhode Island and Maryland.

As the CBRSWG continues researching best practices in managing multiple shellfish species, per-species endorsements may be an effective solution, as they have been successful in other states (Table 4). However, each town should be cautious about the number of endorsements they offer for each species, as well as the total number of licensed harvesters, in order to avoid overfishing soft-shells or quahogs (Box 3).

4.6 Surveying

Ideas Moving Forward
1. The working group could continue looking into improving survey techniques and working with the state to determine a standardized protocol for surveying multiple species to collect better data that can be compared town by town.

All four other states we researched have set standardized survey protocols that are conducted by the state, or by trained personnel in each municipality (Table 5). This increases the accuracy of surveys, and also allows data to be compared between municipalities because they are using the same survey technique. Currently, the DMR recommends the Belding method[5] for surveying soft-shell clams (and sometimes quahogs), but there is no existing standardized method for surveying for multiple species at once. It may be beneficial for the CBRSWG to collaborate with DMR biologists to create a standard survey protocol for towns managing multiple species, and train each person responsible for conducting surveys on that protocol.

4.7 Washington State Case Study

Ideas Moving Forward
1. Standardize survey protocol between co-managers 2. Design surveys to provide an understanding of clam population levels to inform management practices 3. Ensure active and consistent communication between co-managers 4. Enforce regulations to ensure fisheries' long term health

Though Washington State utilizes tribal Co-M rather than municipal Co-M as in Casco Bay, there are many successful practices in Washington that can be applied to management in Casco Bay. Through research and interviews with scientists who are part of tribal Co-M in Washington, the above four key ideas stood out and might be of interest to managers in Casco Bay.

[5] https://www.maine.gov/dmr/shellfish-sanitation-management/programs/municipal/forms/documents/SoftShellPopulationSurveyFieldGuide.pdf

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APPENDIX I: STATE INTERVIEW QUESTIONS

Explain project and my involvement in working for the Casco Bay Shellfish Group in Maine

1. What is your involvement with shellfish?

I am hoping to gain a better understanding of five main topics in terms of management of multiple species of shellfish, specifically different types of clams

2. In Washington, do you practice co-management?
    a. If yes, what are the roles/responsibilities of towns and state agency? What are strengths/weaknesses of managing this way? What would you change if anything?
    b. If no, who is in charge of managing clam species? Are harvesters brought into the conversation in terms of decision making? What are the strengths/weaknesses of managing this way?

Conservation:

3. What resources do the management bodies put into shellfish conservation?
    a. Are harvesters required to volunteer hours?
    b. What conservation activities work well at maintaining or restoring shellfish populations and why?

Licensing (SKIP IN RHODE ISLAND):

4. How are licenses allocated for different species?
    a. Do you have one license for all species or different licenses for different species?
    b. What are the requirements to obtain and keep a license?

Reporting:

5. What kind of reporting do you require?
    a. How does reporting differ for harvesters and shellfish dealers?

Surveying:

6. Do you conduct regular surveys for the various shellfish resources?
    a. How often are these surveys conducted?
    b. How do you conduct the surveys? What methods are used?

State Agendas:

7. Is there anything that the state is trying to do now in terms of shellfish management?

Additional Questions:

8. Is there any additional literature online that I should read in regards to shellfish management in this state?
9. Do you recommend talking to anyone else?
10. If any, what monitoring (water quality, temperature, etc.) is done in the shellfish ecosystem in your state?

APPENDIX II: CODED INTERVIEWS

Code Key:
conservation practices
license allocation
survey methods for multiple species
monitoring
governance system/co-management
reporting/assessment

Massachusetts 1
Barnstable, MA
March 3, 2020
10 am

I started by just explaining the project we're doing

N: What is your exact involvement with shellfish in your position?

A: Right, so I'm the shellfish constable of the town of Barnstable. So any management changes or regulatory changes essentially are vetted through me. Also a natural resource officer, there are a handful of us in the department and so we're responsible for all enforcement of shellfish-related state, federal, and local regulations. We do have a shellfish biologist and a shellfish technician on staff, and they're responsible for the farming part of the propagation program. And then we do also, depending on who is around at the time, we do educational outreach to the public in the form of classes. You know, learn to shellfish, clamming classes for kids, all that kinda stuff.

N: Great, so in Massachusetts do you practice co-management?

A: Co-management?

N: Yeah, it's something that they're trying in Maine. That's kind of the point of this working group, is to have harvesters come together with some of the people in more management and regulatory positions like yourself to talk about enforcement and different regulations like all together.

A: So in the state of MA, because the state isn't managed… well the shellfishery in the state of MA is ultimately managed by Division of Marine Fisheries, which is a state entity. However, in

MA we have what is known as home rule, and so that gives authority to your local municipalities to manage their fisheries as they see most appropriate, so long as they're not being more lenient than what the state allows. So each community that has a shellfishery across MA is managed by its own municipality, and so is therefore extremely different, from town to town and city to city. Within a town, say for instance like our town, we have what's called a shellfish advisory committee. It's comprised of people who are commercial wild harvesters, that are aquaculturists and that are recreational shellfishers. And they come together every month to discuss pending, notice of intent, things that would impact shellfish areas, to discuss ideas that perhaps the aquaculture, recreational, or commercial industries may have. And then those suggestions are sort of vetted through town government to either affect a change or to decide that a change is not warranted at that time.

N: So what do you think are some of the strengths, and potential weaknesses of that system?

A: So I definitely think that one of the strengths of that system is that the coast line is very dynamic within the state of MA, although it's small. And what you have available to grow and what you have for standing stock varies greatly from one location to another. And so having the ability to manage it on the ground level, rather than just as an entire state where blanket regulations may have an adverse effect in one area, but could be beneficial in another, I think is beneficial in the long run to the municipalities, and that it gives them the opportunity to, with a very close eye, monitor regularly their fisheries. I think probably one of the weaknesses of it is, because it changes from town to town, it can create issues for both the aquaculture industry and for commercial harvesters that may have specific items in mind that say, could be applicable in one town, but may not be applicable in the town that they work in. And so it can kind of put people at a perceived disadvantage in that way, but that's why you have these shellfish advisory committees so that these people, if they feel that there might be an opportunity to change something, have a vessel by which to bring that up.

N: So who makes up those committees exactly?

A: So it depends from town to town how it's listed. In our code, I think it's chapter 241, committees. So currently on our shellfish committee, it's comprised of no more than 3 commercial shellfishermen, one of which would also be, in addition to a wild harvester, an aquaculture licensee. No more than 3 family permit holders, which are your recreational fishers, one person professionally trained in the aspects of shellfishing, which could be somebody who is a biologist, or it could be somebody that only operates an aquaculture farm, and then no fewer than two members at large. So in our town it's a 9 seat committee, and then they have a councilmember liaison through that committee.

N: And so then, if other harvesters that aren't on that committee wanted to have a say, they would do that…

A: At the monthly meeting. Yeah, you just show up and if they want something specifically put on an agenda for lengthier discussion they can request to do so before that agenda is due. You know by open meeting law we have to have it, I think permanently posted, 48 hours prior to the meeting. So they can either ask to have something specific put on the agenda that they'd like to spend a specific amount of time dedicated to. Or, if it's something they just want to lob out there, there is a section of the meeting called 'matters not reasonably anticipated by the chair,' and that's their other way. I mean they also can come to me, as their shellfish constable, at any given moment in time and bring a concern which I can bring to the rest of the department. But typically, even when we have that situation happen, if it's gonna result in a regulatory change, we prefer to vet it through the shellfish committee even though they're advisory, just because it makes towns government more happy because it's a more cohesive approach.

N: Right yeah that makes sense. So, do you have people coming to you often?

A: Oh my god, all the time! All the time! Yes, their Christmas lists are never-ending

N: One thing that's a rule in Maine, that differs by municipality, harvesters have to put in a certain number of conservation hours working on different projects in order to keep their license, do you guys have something similar to that, or no?

A: Oh! We do not. We currently have started a Clean Harbor Initiative with our aquaculturists, asking them to participate in what we're calling Harbor Clean Up Months. It's not mandatory right now. We're trying to take, you know, the decent approach of 'yes what you do is good for the environment, but it can also be harmful to the environment. You need to be responsible for both of these things. And it's in your best interest to participate in projects like these because it shows that you're accepting responsibility for the potential environmental detriment that aquaculture can have, but also shows that you're invested in having a healthy environment around what you're doing. And so right now it's voluntary. That may change in years to come, depending on involvement. But we are hopeful that our growers will just fall in line and will become as invested in it as we are.

N: Well that sounds like a really cool program. Do you have any ideas about what conservation activities work well at maintaining or restoring shellfish populations, just for our own research?

A: So we do on occasion what we call contaminated in-town relays. So we are effectively moving stock from areas that are conditionally restricted into areas that are in open status. And then giving those shellfish a chance to clean themselves, and then also supplementing your

natural population and also creating these sort of depo areas for people to harvest once those animals test clean. It's a good way to kind of turn up the bottom in areas that aren't allowed for normal harvest. It's a good way to get rid of some of the larger animals in those areas, depo them out of there, giving chances for new seed sets to come in. So with stuff like that, I think that any type of clean-up is good. We don't really have, like our propagation is done, it'd be great if some of the commercial guys wanted to help out, but we have a distribution volunteer list of over 200 people. So, when our shellfish technician, Liz, puts out an email to the general public that she has on her list to come volunteer for like a, quahog seed planting event, she always has plenty of people that turn up to do it.

N: Well that's great that people are interested.

A: Yeah, I mean we participate in coast sweep every year. But we don't have any specific tied to the industry conservation, like initiatives going on.

N: Okay that makes sense. So do you have one license for all species or do you have different licenses for different species? And is that up to the town?

A: So in the 90's we had per-species licenses, in I think the year 2000 or 2001, it all became one master permit if you're a commercial harvester, which covers you for all species that we have a commercial fishery for, which are everything with the exception of oysters. We don't have a commercial oyster fishery in this town.

N: Okay, and does that system differ town by town in Massachusetts?

A: Absolutely. Like we also have a closed fishery, there's 47 commercial licenses that are offered annually to the same people. Somebody would have to not renew for a new person to come in, and there's a lot of re-system every year to make a list of those people who would be offered a permit should one become available. In other towns there's no cap, you know they have well over 200 harvesters, but they may only be going for soft-shell clams. It varies greatly, just on Cape Cod it varies greatly, never mind the rest of the state.

N: So could you tell me an example of another town where they do have different licenses for different species?

A: Um, I'm trying to think… I have homework for another town that I think does a permit by species. (She sent me one in an email after the interview! Chillmark, Martha's Vineyard)

N: So do you have specific requirements to obtain and keep a license in Barnstable?

A: Yes. So our regulations as they pertain to the commercial fishery are: you gotta live in town, you gotta be domiciled here, we don't want anybody in the fishery that's not domiciled here. And as a part of that annually, you need to complete a renewal application, and in that application you need to provide us with proof of your domicile, you need to pay a $5 non-refundable renewal fee, you need to provide us with a stamped copy of your previous years catch report, and a current commercial permit with the state, that shows that can legally sell these shellfish once you go to market. At the end of the application window they have 90 days to complete payment in full, for a master license it's $550, for a senior license which is anyone 65 years and older it's $350. All of our permits expire March 31st annually, and so they need to go through this every year. We also have an apprentice commercial shellfishing permit, that is available to people who are over the age of 12 I think and haven't turned 16 yet. And so long as they're sponsored by a commercial shellfisherman, or woman, once they clock 400 hours in the apprentice program, they can apply on their 16th birthday for a commercial permit. So that's really the only way for someone to get around the cap on licenses currently. Back in the 90's we had over 200 people in the fishery. They were severely overfishing the soft-shell clams that were in Barnstable Harbor, and so at that time they decided that they weren't going to add new people in for those that didn't renew. And then they ended up changing from per species to this one master, and through the process of attrition, we arrived at 47 and that just became the magic sustainable number that we've been at ever since.

N: That's great. So what kind of reporting do you require that harvester do, and does that differ between harvesters and shellfish dealers?

A: So we only have a couple of growers, of aquaculturalists, in town that are also dealers, but we don't require any reporting, all of that is done through the state. We require all of our growers to follow the vibrio compliance management plan year to year, and we have a natural resource officer who is dedicated as our aquaculture specialist, to ensure that they're following all those regulations during that 6 month period of time. And then reporting-wise, we get annual reports from our growers, and we get annual reports from our commercial harvesters. And that's really all that we require. Other than that, we're checking you at the landings anyway, so when we see you we're making sure that you're in compliance with all appropriate and applicable regulations.

N: Right, that makes sense. So do you conduct regular surveys for the different species?

A: So we're sort of out and about all the time, and when we're not out and about all the time, the fishery is out and about all the time. So if we, you know, hear a report of a decent soft-shell clam set, we'll go check it out and sort of quantify it, qualify it. You know we do that if there's ever a report of some awesome sort of set that happens, because typically when there's an awesome set of something, there's also gonna be a question of the commercial fishery to have extra access to it. So you wanna definitely get an idea of what's out there. But by and large, because our

shellfish biologist has been here since the mid 90's, we've pretty well established where everything is at this point. And while we face habitat loss and degrading water quality, you're not really seeing anything like astronomically amazing happen, it's more like what you're losing at this point. Which sucks, but it's true.

N: So you're not really doing like transects and quadrats and that sort of thing?

A: No, I mean say for instance, last year the commercial fishery was saying that they really wanted extra days of the week to go harvest soft-shell clams in Broad Sound, in Barnstable Harbor. And we said okay, well, is this warranted? We don't know! So you go do a survey. And that's when we do those kinds of surveys. We also do those kinds of surveys for any NOIs (notice of intents) that have piers, you know any work that's gonna be done that will affect a shellfish area. And we also do those kinds of surveys if there's someone that is applying for an aquaculture license that's not already in an approved area.

N: Okay, so it's like a case by case kinda thing?

A: It is, yeah.

N: And who would be conducting those surveys when they need to be done?

A: Most often, the shellfish biologist. But if he's not available, either the shellfish technician, or any of the natural resource officers are suitable for that. We all know how to do it, most of us have biology degrees, so we've done that at some point in time for some sort of animal.

N: Something interesting that's been happening in Casco Bay is that one of the conservation projects that harvesters can work on occasionally is doing surveys themselves. But then, they've run into a lot of problems with not having a standardized protocol, or people being suspicious that they're lying about the results.

A: We base it all off how the state does their surveys. And in the case of like piers, and notice of intents, who are applying to have that work done, have consultants that do their own surveys. And then we also do surveys of those areas, just for consistency purposes, and to make sure that kind of thing isn't happening.

N: Okay yeah that makes sense. So is there anything that the state is trying to do now in terms of shellfish management? Or Barnstable too if you know more about that.

A: So I mean, right now, the state is just starting to get all of the water quality sampling that they need to do. Their staff has been severely butchered, over the past few years, and people have

retired. And so they're understaffed, and the requirements to keep areas open are daunting, and so right now their biggest focus is to work with whatever the FDA decides is going to be the final determination on how marinas and mooring fields will be managed moving forward, and then to meet the demands of the water quality testing to keep open areas open. Very rarely do they have the opportunity to put in the time to reopen an area that's been closed for pollution reasons. They're very busy with that. And other parts of the state have been doing things out in Buzzards Bay where the oil spill was, for a number of years they've been replanting quahogs and providing floating upwellers to the towns that were affected. Biotoxin monitoring is huge also.

N: Okay, so is all that monitoring done by the state then?

A: Yes, yeah.

N: Great, so do you think that I should talk to anyone else?

A: Oh my gosh, yeah! I'm just one town! I mean, you could pick any town really in the state of Massachusetts and talk to them because they're gonna have a completely different thing to say. But you might also want to talk to someone at the state. I think that the person in charge of their area biologists is [Massachusetts 2], and he's been with the state for a long time and hasn't retired yet, so he's probably a good place to start.

N: Thank you that's super helpful!

thanked her for her time

Massachusetts 2
State of Massachusetts Division of Marine Fisheries
March 9, 2020
12:15pm

introduced myself and the project

N: Can you explain your exact involvement with shellfish in your job?

G: What happens in, Division of Marine Fisheries was given the authority to, how do I put this… anything shellfish-related goes through the DMF, for any commercial or recreational entity. For instance, we have two field offices, one in New Bedford and one in Gloucester, and we do halfway up to Boston, and they do from Boston north. I'm in the south on Cape Cod, Martha's Vineyard, Nantucket, Buzzard's Bay. And what happens is we, in a nutshell, classify shellfish

beds. There's 5 classifications: approved, conditionally approved, restricted, conditionally restricted, and prohibited. Approved means you can shellfish in those areas, from our point of view, the Division's point of view, any time under any condition. Conditionally approved, for instance, is classified approval based upon a certain condition. For instance, the most common condition is it's closed during the summer when the warmer waters are out, the bacteria will multiply, and more things going on around the water. There's also one based on rainfall, which up in the North Shore and down here we have rainfall areas, it's approved based on rainfall. So when a certain amount of rainfall falls within a 24 hour period, the area's closed for generally 5 days. It varies but that's the main thing. And then there's other ones. And then restricted means that that does not meet approved classification, but it's mild fecal contamination. And those areas are used for contaminated relays, that I oversee for the state of MA. Then there's conditionally restricted, which means it makes restricted generally probably dry weather, under certain conditions. And then prohibited means it's bad water quality and you can't do anything in there. So those are the 5 and that's through the model ordinance, which is chapter 4, that's everything we have to go by to classify areas. We also run the contaminated relay program, which, right now, the source of quahogs is Taut (sp?) River. And municipalities contact myself and the dredge boat captains, I permit them, and I oversee the entire program, to where they pay the dredge boat captains so much a bushel, to bring the quahogs to them, and they plant them in approved or conditionally approved areas, and then we let them deparate for a minimum of three months, so that they can spawn also, and then after that we check them and then the town can open up after that. We also run an aquaculture program, which I think there's probably around 300 aquaculturalists now in MA, give or take a few. And we do all the permitting, the site surveys, everything that goes along with dealing with the towns. We also run a harmful algal bloom section, which is generally red tide, amnesic shellfish poisoning, diuretic shellfish poisoning, all these different things that are in the water at certain times of the year, planktonic, that can make shellfish inedible. At that point, there's just a whole list of things that we do. We deal with the towns one-on-one all the time, we deal with the Mass DET, which is another state agency, who has their jurisdictions. I mean Divisions does an awful lot, but for shellfish those are the general highlights. There's a few more but those are the big ones that take up the most of our time.

N: Great! Back to the way that you label different areas, can you explain the connection between rainfall and opening or closing an area?

G: Sure, as far as rainfall goes, I'll give you an example. 2006 the town of Swansea had been closed for 25 years approximately, and they wanted to try to reopen their areas. So we did a 2 to 2.5 year sampling program, during dry weather, during wet weather, different rainfall amounts, during the different seasons. And when we got all the data back, what I found was, during rainfall they sometimes had elevated counts. But during dry weather, generally the area was good, it met all the criteria. So from that, and knowing how many storm drains and brooks, et

cetera, were along the shoreline, we had no choice but to make it a conditionally approved area based on rainfall. So with all the data that we had accumulated, we found out that after 3 days, the pollution event subsided, and what level of rain triggered the pollution event. And then the fourth and fifth days were for the shellfish to deparate themselves. So whenever they have more than 0.3 inches of rain in a 24 hour period, and they read their gauge every morning at 5 am, if they see that they're closed for 5 days, and they reopen on the 6th. If they do not have any rain over 0.3 then the area stays open.

N: And is that for every town in MA with a fishery?

G: Every town is assessed, there are certain towns that have rainfall problems. Cause stormwater runoff is one of the biggest problems we have, a lot of towns have large prohibited areas where you can't shellfish. So if there's stormwater problems up there, it's kind of academic because the area's already closed. But in these areas where we're trying to get shellfishing allowed based on the criteria, we could not make it an approved area where you could go shellfishing before, during, and after rains. It was only after 5 days after a rain event was triggered, do we allow shellfishing.

N: Okay, thanks, that helps me a lot. So I know that in MA you have the home rule thing, where towns can regulate how they wish. So what is your interaction with different towns? How does the DMF… what do they control compared to what the towns control?

G: We deal with the towns one-on-one all the time, they're our partners in this. Without the towns then we can't get our job done, cause we rely on them and they rely on us. The towns through the general laws have authority over their approved areas, and conditionally approved when they're open. Which means, say you have a 200 acre embayment, and the town says "well, these 50 acres in the northeast corner, they've been fished out." So what the town can do for 3 years is put their own closure on it, so the management closure, and they can propagate that area. So we still consider the area open to shellfishing, but the town has closed it so they supersede us on that. All the different classifications are based on us. And that's the way it has to be. So if we ever classify something prohibited, the town cannot do anything in there, except potentially aquaculture, growing seed to be planted out when it's very small so no one can harvest it for direct consumption. We consider the town's our partners, and we discuss an awful lot with them. They're the ones that are there all the time, they know some things that we don't. So for us to make a decision we need the information from the towns. But they do have the ability to do management projects, management closures, on their own. Now sometimes they will purchase seed from a seed hatchery, and put them into these areas, or just propagate their towns. And they need a permit from our department to possess seed smaller than the legal size. Cause no one can possess seed smaller, so they need a permit.

N: So what kinds of surveys does the state conduct? And when?

G: The surveys the state would conduct for aquaculture sites, proposed aquaculture sites, I'm not the guy to ask for that, but they do go out and survey all the sites to make sure that they're not gonna permit a productive area. I forgot if it's 2 quahogs per foot or less, then it's considered non-productive, it's something to that effect but I'm not sure the exact number, cause I don't deal with it. So that's when surveys would be done. Once in a while we are called on if there's gonna be, say, a dredge project, which probably 4 years ago was gonna happen in the town of Swansea to deepen the channel. The town contracted a dredge boat, and I was on the dredge boat for a couple of days, just going through seeing how much shellfish was there and moving it so it did not get destroyed during the dredging process. We used to do dock and pier surveys when a pier was proposed to go in, but we just don't have the time, so a consultant or the town will do that for us. Sometimes we do mitigation and restoration projects where surveys are required. Cause when we put in the shellfish, we know we're not putting them into areas that have a lot of shellfish, cause we're trying not to stack them on top of each other but basically enhance the fishery. So those are the kinds of surveys that we would do.

N: Thank you, are there any conservation projects being run by the state?

G: Conservation in which way, cause I could take that 2 or 3 different ways?

N: Like, maintaining and restoring populations. Cause I know here in Maine they require that harvesters themselves work on conservation projects for 10 hours to keep their license, so I'm just wondering if you have any projects that might be similar to that…?

G: Let me see about that, well I think we're in the 5th year, it's called the B-120, it was an oil spill barge, an oil spill from a barge whose name was B-120, back in April 2003, I believe. It closed all of Buzzard's Bay and different areas for months and months and months, so there was a settlement. So we're, cause of the lost fishing days, we have a project going. One of them is a contaminated relay project to replenish areas, the commercial shellfishermen were paid for what they would have gotten out of those months in the different areas they were fishing. It's an enhancement project, but it's not necessarily because of a lack of shellfish in the areas, it's more due to the lack of fishing effort due to the closure from the oil spill, that we're trying just to make up and make it more worth their while. The town's do a lot of propagation work, they'll buy seed from a hatchery that's been approved by us, and get it really small, put it in their upwellers, and let it grow until it's about nickel-size or so. And then in the fall when the predation gets a little bit less with less crabs, then they'll put it out on the public beds. Some towns will have their own places where they will spawn shellfish, just to cut out the middleman. The way they towns manage their fisheries is, for instance, Westport, I'll give you one of Westport. They do an awful lot of contaminated relays, they relay about 3,000 bushels of

quahogs every year, into about 5 different areas. So what they do is, so the fishermen don't go into area number 1, they clean it out, they only allow Tuesday, Thursday, Saturday fishing. That way it makes the fishery last longer, it doesn't flood the market with shellfish. Cause they could get 4 bushels, there's probably about 20-22 boats, there's like almost 100 bushels a day going into the markets, so that could flood it pretty quickly. So that's how they manage it also, so they do have a nice management program where they can control the fisheries also.

wrapped up interview and thanked him for his time

Rhode Island 1
Coastal Manager
University of Rhode Island
February 26th, 2020
3:00 pm

introduced myself and the project

J: What's your involvement with shellfish?

I: I am going to answer that two ways. One is that we have a fisheries and aquaculture extension here but she's (Azura) away on sabbatical so that's why I didn't encourage you to talk to her. She is the real expert but I am the one that helped create the bone behind the Rhode Island shellfish management plan. I am more of a coastal manager. I have been engaged in and working on shellfish management in the state of Rhode Island in that capacity, where over the past couple of years Azura has really been the lead in it. I was the one that basically put the framework together for the Rhode Island Shellfish Management Plan and got it running and then Azura took it over.

J: In Rhode Island, do you practice co-management?

I: Yes.

J: So the municipalities have some say in what happens with their shellfish?

I: Well, when I say co-management I am thinking about the wild harvesters and the government. In Rhode Island it's more the state. So we have state agencies, state department of environmental management and the Rhode Island coastal resources management council and both play a role in managing and regulating shellfish activity, whether it be wild harvest or aquaculture. But there are advisory boards and because of the shellfish management plan most recently, there has been

a significant amount of traction and co-management between the harvest community and the state. In addition, I know that Maine has the sea grant program, Rhode Island also has a sea grant program and for several years, our sea grant program would only fund research where the researchers would have to work with the wild harvesters as well as the state entities. This isn't co-management but it creates research that is being implemented by researchers and regulated by the industry together. We're all learning together so to speak and then that research would then be incorporated into writing policy and decision making. So there was sort of that creation of a buy in, where the people trusted the information because they were a part of the research.

J: So what you're saying is there's a collaboration between the wild harvesters and that state agencies?

I: Yes but I will say the wild harvesters do not have a formal role, they are more advisory to the state agencies but there's definitely a respect between them. It's better sometimes than the other years but for many years now I think there's been a good strong respect between the state agencies and the wild harvesters in trying to solve problems and issues together and that turn around happened recently because of the creation of the shellfish management plan and the process that was used.

J: What do you believe the strengths and weaknesses are of managing this way?

I: The strengths obviously is the buy in from the beginning and being realistic and pragmatic in creating policies. I clearly think that for the long-term and sustainable resource management, it's the way to go. As far as the disadvantages, obviously it takes longer but again it's more sustainable I think. Before the shellfish management plan, there was a time here when there was less animosity between the regulators and the harvesters. They were mad at each other and they said the regulators were managing just because and they were calling it safe based management because there was a lot less science behind it. The relationship was not necessarily there and therefore management was strained. I'm not saying things are perfect but they were improved because of that process where we established a plan and the whole process got everyone to sit around the table and talk about issues and realistic solutions.

J: Is there anything that you would change about managing this way?

I: I would say that our department of environmental management continue to get hit financially and their staff get cut so it's hard for the state agencies to do everything that maybe they should or they could and be as proactive and strategic as they could, and again it makes economic sense in my opinion to fund these agencies so that co-management can be effective. I think also an objective entity, that's trusted by both sides- like a sea grant program or another program- adds value to this process because there is conflict and then someone can mediate a conflict and

sometimes you need to make sure that the science is understood. I think that an entity that can serve as that objective entity that can bring the best available science, not only from their own state but other places. We did that right up front. We looked at Nantucket for example, we looked at other places and plans and had research done so that our wild harvesters and our regulators could learn together.

J: What resources do management bodies put into shellfish conservation in Rhode Island?

I: I don't know honestly. I know we've just been approached by our department of environmental management to reinvigorate our restoration plan, our shellfish restoration plan, but I don't know how much money it is. I do know that there are programs that do that, I know Azura would know that but I am not as well versed in that. There are many programs that do that and again, a lot of times they either pay or the wild harvesters volunteer to help with that, with conservation, both the monitoring and the re-laying and transporting. That does happen every year and again it's in partnership with the wild harvesters and the state.

J: Do you know if the harvesters are required to volunteer hours for the conservation projects?

I: They are not

J: Do you know what kind of reporting is required by the harvesters and the commercial fishermen in Rhode Island?

I: Well I know that every bag that they bring in has to be labeled to document specifically where they harvest the clams and they have to sell them to a dealer. They cannot sell them. A dealer is the only one that can sell clams and that's for health reasons.

J: Do you know how you become a shellfish dealer?

I: You need to get a permit. There's a process. I forget who is leading it but I believe it might be the department of health here. You can probably find that online but I do know that Azura and others have been organizing events with the department of health and the department of environmental management and wild harvesters to try and streamline the process so that the harvesters can have more access to the market. We have made some headway on that but still, right now, you have to be a dealer in order to purchase the clams.

J: Do you know if Rhode Island conducts regular surveys for their various shellfish resources?

I: Yes they do.

J: Do you know how often they are conducted?

I: I can tell you who to talk to. I would suggest you reach out to Jason Macnamee.

J: What monitoring- water quality, temperature, etc- is done in the shellfish ecosystem in Rhode Island?

I: You would have to ask Jason that question.

thanked interviewee for their time and ended interview

Rhode Island 2
Primary Investigator on Bay Quahogs
State of Rhode Island
February 27th
4:00 pm

introduced myself and the project

J: What is your involvement with shellfish?

D: I guess I am the primary investigator on bay quahogs in Narragansett Bay and work on a lot of the management issues and regulations.

J: In Rhode Island, do you practice co-management?

D: Co-management in the sense of management by municipalities like in Mass?

J: Yes

D: Not really. Rhode Island has more of a constitutional based authority over shellfish. The difference here from Mass is that it was built into the constitution but the town could have some control over it. We work collaboratively with lots of groups but ultimately the authority lies with the state.

J: So the state is kind of in charge of managing all shellfish? I am specifically looking at clams if that helps.

D: That does. Like block island is a shore town in Rhode Island and we have given them a little leeway to manage collaboratively with us but ultimately the authority lies with the state more than with the towns.

J: Are harvesters brought into the conversation at all when making decisions?

D: Sure. There's kind of a process with an advisory council called the Marine Fisheries Council. So the members can solicit to be appointed to that board and then within that group there is a subgroup called the Shellfish Advisory Panel so whenever we want to vet new regulations or make modifications or whatever the industry wants to introduce language or even recreational, there are even recreational members on it as well, so it's a pretty transparent process for regulation development or management purposes.

J: What resources do the management bodies put into shellfish conservation?

D: The commercial fishing license receipts are in part used to enhance management and access to the resource but also helps fund the surveys. For example we have a dredge survey that is done annually and we have Narragansett bay mapped out and we do representative dredged tows within boxes throughout Narragansett bay and then with the ponds we have a slightly different survey but the bulk of the quahog landings are in the Narragansett bay.

J: Do you have specific conservation projects that you are undertaking?

D: We have areas called shellfish management areas so the state has the authority to propagate more restrictive regulations when an area is designated as a shellfish management area and that include management enclosures so we have, within certain areas of the bay and the coastal ponds, spawn sanctuaries we call them but basically they are closures that allow breedstock to remain in place. The coastal ponds are shallow and get a lot of recreational pressure and some commercial shellfishing pressure so the sanctuaries are a way to have breedstock remain. In addition, we sometimes do re-lays into those sanctuaries which allows breedstock to be in high enough abundance to result in some level of recruitment for future harvest.

J: What conservation activities work well at maintaining or restoring shellfish, specifically clam, populations and why?

D: I think what I was just describing is some of the better ways to result in sustainable harvest because the coastal ponds are pretty shallow and the state allows public access so it's pretty easy to overfish the areas that fishing is permitted so the management method of having some kind of closure ensures pretty substantial recruitment but also if it were not closed it would be difficult to keep it sustainable. One of the other aspects that is sort of done as a by-product is some of the

pollution closures, there's many times very abundant clam densities, and because it is closed for water quality issues, those clams can still spawn and replenish areas so it's really about preventing overfishing and then have enough breedstock to replenish what's fished. It's been going on for a long time here and seems to be an effective method.

J: Are harvesters themselves required to volunteer hours in these conservation efforts?

D: Not exactly. What's been done in the past, for example with the relays we were talking about, is some of the money from the license receipts but also in addition this year one of the treatment plants in the northern part of Narragansett bay had received fines and so rather than just using the money for other purposes, some of the money is going to be used to help fund one of the re-lay transplants into areas. So for example, the fishermen don't do it voluntarily, it's elected but they can get paid to help move those clams using those funds. So what we do to keep it simple is we use peat bags and if you fill the clams up to the label on the bag it's around 50 pounds so they get a credit and they ultimately get paid. Now they could get a lot more if they could sell them but because their coming from unapproved waters, so we re-lay the clams in clean water in the spring, the clams are allowed to spawn over the summer, and then in the winter time those restricted beds are allowed to be fished. In a sense they are voluntarily moving them but they also derive a benefit from it. But it's closely supervised by the state. States like New York require people to get a license to do that sort of thing but we stay pretty strictly on top of it to make sure there's no health risk and we don't want to overfish the bed that's going to be the source bed either.

J: What kind of reporting do you require? By the commercial fishermen and by the harvesters themselves as well.

D: So the fishing licenses that they have are swipe cards and then there are licensed dealers that are able to purchase shellfish so any fishermen that wants to sell their catch, they go to the dealer and they swipe their card and whatever they sell to the dealer goes directly into a database and in addition, we have a tagging area map, and on they have to tag where the clams came from which will be credited in the database so we have a better idea of what's being removed from the different areas. So they do have a reporting requirement and if they don't report it, then they can't sell it, is what it kind of comes down to.

J: So they have to swipe their card with every dealer that they sell their shellfish to?

D: Right. And then again, it's tracked so say we got a particular area, like those salt ponds or certain parts of Narragansett bay, we combine the data that the dealers provide from those landings with our survey data and then other aspects that we're familiar with and try to get a feel about whether, well if you think about it broadly it's not overfishing of bay quahogs, but we

kinda classify it as localized depletions and then those management areas that I was referring to earlier gives us the ability to either have more restrictive possession limits or seasons to prevent the localized depletions that way.

J: I know you were talking about the dredge survey, do you conduct any other surveys?

D: Within the salt ponds, we have a kind of comical device, we call it the clam suck but we have a suction sampling device that's used. It's a smaller scale survey but we randomly place quadrats a square meter in size and that suction sampler excavates that quadrat and then everything from the undersize and other invertebrates all the way to legal size shellfish, not just quahogs but other species as well, are all measured and quantified.

J: Could you just briefly describe the dredging survey again?

D: The Narragansett bay there are areas that are fished heavily and then there are other areas that are un-fished, either because of pond depth or water quality or whatever the issue is. But again, the stocks, because they're all public stocks and under public ownership, our responsibility is to survey in that particular manner. We have a map that lays out the different areas. It's a little bit time consuming but we do roughly 50% of those stationed boxes per year in rotation. There are certain areas that we do every year because of the shellfishing pressure and we are trying to stay on top of the impacts. The way it works is the very small hydraulic dredge is towed 100 feet and then everything that comes up within the dredge, we know the sweep of the dredge and ultimately square meter polygon area and then we come up with abundance density and size distribution for the clams within that footprint. That's been going on for a very long time so we have a long term dataset for fished and unfished areas and the overall abundance.

J: Are both of those surveys conducted annually?

D: Yes. The suction sampler survey was done intermittently but as more people come on here it's being done with greater regularity. All the ponds are shellfish management areas. It's done every year but not every pond is done every year. That's done rotationally also.

J: If any, what monitoring- water quality, temperature, etc- is done in the shellfish ecosystem in Rhode Island?

D: We do that type of work when we're out surveying. But additionally, the water quality people as well as the health department have come out with guidelines and recommendations of how shellfish have to be handled when temperatures in the fished areas reach certain levels so there's more restrictive when, in the winter it's not an issue but in the summer it could be, so like how quickly the quahogs are chilled and how long before they can end up marketed. Those things are

pretty closely monitored and regulated and the shellfishermen, as part of the process, they've had to receive some online training and law enforcement is pretty on top of ensuring that they're complying with the shellfish safety.

thanked interviewee for their time and ended interview

Rhode Island 3
Chief of the Marine Fisheries Division
State of Rhode Island
February 27th
12:00 pm

introduced myself and the project

J: First, I just want to know a little bit about your involvement with shellfish.

I: I actually just got a promotion but up until last week I was the chief of the marine fisheries division in the Rhode Island department of environmental management so I kind of ran the marine fisheries division and shellfish is a part of the marine fisheries division.

J: In Rhode Island do you practice co-management?

I: The way that I would define that, in particular with shellfish, is a lot of the regulations we develop or management plans or what have you, they are all done in collaboration with our local industry.

J: The role of the towns is kind of just to inform the state agencies?

I: It's a little bit different in Rhode Island then it is in say Mass. There is really no municipal control over shellfish management, it's all done through the state. The one exception to that rule is the case of Block Island, which is an island off the coast of Rhode Island. They do have some authority over their shellfish resource but the rest of the state is all managed by the state.

J: What would you say the strengths and weaknesses are of managing like that?

I: I think that it is pretty robust. In the past, we weren't really well with our industry until we worked through if there were reductions needed or if areas needed to be closed. We worked through that stuff collaboratively. When the authority lies with the state, the state can basically ignore the industry. We don't do that now, but in the past there was more tension between the

industry and the state because they felt the state did things without their advice more frequently. That just came down to developing better mechanisms and more transparency and things like that. That's the weakness, when it lies solely with the state, there could be a tendency to have the system be a little bit more opaque and harder to understand if you don't have really good open channels with the industry.

J: Is there anything that you would change?

I: No, like I said I think we have changed things for the better in Rhode Island so I'm pretty happy with how our management system is working.

J: What resources do the management bodies put into shellfish conservation?

I: That's a good question. So the state puts very little direct resources, they don't give us a lot of money to do conservation and things like that. Our main source of funding for doing our shellfish work comes from license receipts and so fishermen buy licenses and that money goes into a restrictive account that only we can access and that's how we fund the majority of our work. The state at large doesn't invest a lot in our program but the industry does and we also find other ways to bolster our program through going after grants and things like that.

J: What conservation activities do you think work well at maintaining or restoring shellfish populations?

I: We do a few things. One of the big ones that we do is we participate in EQUIP projects, I can't remember what those acronyms stand for, but basically it's our aquaculturists, they get these grants and what they do is, for instance, they create oyster reefs in areas that they're not going to use for their commercial enterprise. They put out colch and things like that and they seed the colch to create natural oyster reefs and so that's one of the programs that works really well. In Rhode Island it's collaborative so the aquaculture industry participants and has a public benefit to it. And then we do a lot of restoration work that coincides with restoring habitat for finfish species. We use federal funding sources to enhance habitat for finfish and sometimes that involved cultivating things like oyster reefs and other types of shellfish habitats.

J: Are harvesters required to volunteer hours?

I: There's no requirement for any of that. It's voluntary and part of the program at marine fisheries.

J: What kind of reporting do you require of the shellfish landings?

I: We participate in SAFIS which is the Standard Atlantic Fisheries Information System. It's an electronic reporting system and that's mainly used by the shellfish dealers. They report twice a week to us their landings, where the shellfish came from, the area and all of that stuff. So that's how the dealers report. Some shell fishermen report through a log book system and we have both paper and electronic versions of that but the shellfishermen that only do shellfish and nothing else, they actually don't have a reporting requirement. But if they have some other endorsement, say for finfish or crustaceans, then they have to report everything to us.

J: Do you conduct regular surveys for your shellfish resources?

I: Yep, we have a dredge survey that runs annually- just a small hydraulic dredge that we go, mainly concentrated on our shellfish management areas, which are in Narragansett bay. So we do have a survey that we run and we also have a series of coastal lagoons in Rhode Island, salt water ponds, that we do small scale suction sampling surveys for things like soft-shell clams. Those are the two standard surveys that we do. And then we do other kinds of one off surveys here and there depending, like if someone wants to dredge an area, we will go out and survey to see if there's valuable shellfish resources there that the dredging company needs to mitigate the state on and things like that.

J: What monitoring- water quality, temperature, etc- is done in the shellfish ecosystem in Rhode Island?

I: There's actually a whole other section of the agency that I work for, the office of water resources, they also have a shellfish program and they do routine monitoring through all of Rhode Island state waters and through our coastal lagoons. They survey for bacteria levels and they also do plankton surveys as well.

J: Is that done annually as well?

I: Yes, in fact they're definitely done annually, and they're done monthly.

thanked interviewee for their time and ended interview

Maryland 1

Head of the Shellfish Monitoring and Assessment Program
State of Maryland
March 2nd
11:30 am

introduced myself and the project

J: What is your involvement with shellfish?

M: My involvement with shellfish is as the head of the shellfish monitoring and assessment program so I do shellfish surveys

J: In Maryland do you practice co-management?

M: Define co-management

J: The cooperation between municipalities and state agencies to make decisions in regards to how shellfish are managed.

M: Clams not so much. For oysters we do have an oyster advisory council. We do have a tide water fisheries committee that, again is an advisory body, and clams will come up occasionally but clams are not always that hot of a topic. The main thing down here is oysters.

J: Who's in charge of managing the clam species?

M: The department of natural resources.

J: And they make all of the decisions on harvest limits and all that?

M: Yes. Now, I will say that you have two bodies of law and regulations that manage the fishery. The laws are set by the Maryland general assembly (elected officials). The department of natural resources can put in an opinion about a pending bill but the laws emanate from the general assembly. For the most part, they give regulatory authority to the department but they also impose their own restriction on fisheries such as size limits or the requirement for fishery management plans?

J: Does the general assembly consult harvesters when making decisions?

M: They have hearings on these bills and anybody can speak. Harvesters will come to these meetings if it's going to have an impact on their activities.

J: What resources do the management bodies put into shellfish conservation?

M: Aside from surveys, regulations to conserve the resources and also as far as oysters are concerned, they've put in restoration money.

J: Have they done anything like that for clam species?

M: They've done a couple of pilot projects for hard clams in the coastal bays but those were actually funded by grant money. It wasn't directly from the department. We also did do some soft-shell and razor clam surveys that were basically a population and disease study.

J: Are there conservation projects going on for clams?

M: No, there's nothing going on with clams. The only thing I can say is there are proposed restrictions on clamming near grass beds. Now there's a pending bill that would put a buffer around these grass beds. But as far as conservation of clams is concerned, no.

J: Do you have licenses for different species of clams or are all of the clams under one license?

M: Soft clams and razor clams are under one license. Hard clams are under a separate license. That's for the rigs that they use, the hydraulic escalator dredge. But what they have to have to begin with is a tidal fish license which allows them to actually fish in any fishery.

J: How are licenses for clams given to the harvesters?

M: They apply for it and they get a license.

J: So you don't have a set number of licenses that you can give out?

M: No. There's no restricted or limited entry on these things right now.

J: Are there any requirements to obtain the licenses?

M: You can literally just apply. Talk to the program head about requirements to obtain different licenses.

J: What kind of reporting do you require from shellfish harvesters and shellfish dealers?

M: Yes, they are required to report. The harvesters have to report their catch and they also have to tag their catch for location and date. That's a national shellfish sanitation program requirement so that we're in compliance with that. So each bushel has to be tagged.

J: What about reporting from shellfish dealers?

M: Dealers have to report also. They have to report the location, number of bushels, and the harvester has to sign off on it.

J: Are they required to report weekly/monthly?

M: I'm not sure. Ask the program head.

J: Do you conduct regular surveys for the various shellfish resources?

M: Yes. For oysters we do a full oyster survey and that's been going on since 1939.

J: And that's conducted annually?

M: That's conducted annually. We have a hard clam survey in the coastal bays. We try to do that annually but right now the fishery is closed to mechanical harvesting so there aren't have harvesters over there that we can use so we have to make arrangements with guys to come on over from the Chesapeake side.

J: How do you conduct the surveys for the clams?

M: For the clams it's with a hydraulic escalator dredge, including the northern quahogs. It's mostly done in our lagoonal coastal bays.

J: Could you explain the methods of how you go about doing that?

M: We have the bays stratified and have a designated number of samples from each section which are selected at random within the section. We go to those stations using GPS and take a 250 foot dredge tow and that's measured with an odometer function on the GPS unit. We collect all the clams and other shellfish. We will note what's there, we will measure everything, and count everything including the boxes of clams to get an estimated mortality.

J: Does Maryland do any water monitoring- such as water quality, temperature, etc- for the shellfish ecosystem?

M: They have regular monthly or sometimes semi monthly fixed stations where they go and take water samples. They also have continuous water monitoring stations in some locations. And also the health department takes measures of *E. coli* bacteria for shellfish sanitation purposes.

thanked interviewee for their time and ended interview

APPENDIX III: WASHINGTON STATE INTERVIEWS

Washington 1
Fish and Wildlife Research Scientist
Washington Department of Fisheries and Wildlife
February 28, 2020
4:30pm

introduced myself and the project

S: What exactly is your involvement with shellfish?

H: I am at the Washington Department of Fish and Wildlife and our shellfish unit has three parts; it is divided into thirds. I am in the third that focuses on dive fisheries so that is geoducks, sea urchin, sea cucumber, scallops, and abalone, although the abalone is not a fishery anymore it is a restoration. There are a couple other thirds—we have a crustacean team doing pot fisheries for crab and shrimp and an intertidal team that does the clams and oysters. I mainly do the dive stuff and run a little dive team that does the stock assessments and a lot of the co-management. We should really talk about what co-management means to you in Maine.

S: From what I've been researching in Washington it sounds like it is mostly co-management between tribal groups. In Maine it's different, there is really no state oversight for restoration and conservation. Quotas are set by the towns in Casco Bay. There's really not enough money to do comprehensive surveys. Diggers are required to do a certain number of restoration hours and some of those hours wind up being surveying. This can get a little dicey because sometimes the states accuse the diggers of not accurately reporting findings. They sometimes think the diggers over report to reduce the number of licenses per town. We are trying to find a way so the towns can still have local control but the fisheries remain protected. I'm hoping to get a better understanding of five topics relating to the geoduck fishery in Washington. The categories are monitoring, surveying, conservation, population recording, and licensing. What are the roles of towns/ state agencies in managing geoducks?

H: We really don't have a quahog fishery but geoducks are kind of analogous. The co-management part is the same with the tribes. We don't have any real role with towns or counties, I shouldn't say any, but not nearly like you do—it's not a management unit. The state is the unit. We certainly have public hearings for decisions that are being made and get input from anybody but it's not really working for the towns. The harvesters aren't really divided up into co-ops like in the lobster fishery. We don't really have anything like that statewide. You can't really talk about the management of anything in the state without backing up all the way to the 1850s.

Those were the treaties that were signed between various native American tribes and the state. My experience is pretty much limited to the Puget Sound and coastal tribes. There are about 15 of them and treaties were signed which gave them the right to harvest fish and go hunting in perpetuity in their usual and the accustomed areas— in exchange for the right to the land that is under western Washington. The state did not honor that right for many many years. In the beginning there was the theory that it was an abundant and sparsely populated land—you could fish what you want. In the modern era, with millions of people in the Puget Sound, those commitments were not honored very well. We had to go all the way to the Supreme Court, first for salmon, but the shellfish stuff did not really get settled until the 1990s. It did not actually say shellfish in the original treaties so the state argued that fish did not mean shellfish--but the court said it sure does. All of our fisheries are 50-50 sharing. Co-management means that no one is in charge, I guess the courts are, when there's a disagreement the only real remedy is to go back to court—and that does happen unfortunately. In terms of the day to day, setting quotas seasons and monitoring, has to be by consensus. No one gets to say this is how it is. There is an Indian fisheries commission. It would be great if we could one on one negotiate with this commission but unfortunately it does not work like that. Each tribe is basically negotiating for itself. They have overlapping areas. They don't have the whole Puget Sound. They have these things called U&As (usual and accustomed areas) that are born out in the courts and stem from the treaty language. When you're trying to design a survey or interpret survey results or make a decision on policy it is a lot like an international decision because these are sovereign nations. It can be very hard to get things done but you do have a lot of other scientists to talk with about it and you get a lot of different perspectives which can be helpful too. Basically, everything we do has to be agreed-upon by a lot of different parties—it's hard when they didn't get along for generations. A lot of lawyers get involved which is not good for science. We have a lot of say over our half of the fishery, but it is only half.

S: What resources do managing bodies put into conservation?

H: The geoduck fishery is the subtidal fishery. There is geoduck aquaculture but that is a separate piece. We mainly deal with the wild fishery. We do restrict all the tract depth boundaries between 18 feet at 0 tide and 70 feet. So there's a lot of geoducks shallow and deep of that, that do exist, and hopefully will never be fished. There are a lot of areas that are in health closures. We don't consider any of that as biomass, we kind of forget that is there. It is a giant buffer for the parts that we are harvesting. We have strategies for these tracts, we have the whole Puget Sound divided up into over 200 of them, and they're kind of historically everywhere. Some of them are really small, 10- or 20-acre tracts, and some are huge, say 800 acres. They really vary in size depending on the area. That is really the management unit. We add up what we think about biomass in each tract altogether which is our Puget Sound harvestable biomass. We are not just saying here is the annual quota for Puget Sound—go get your geoducks wherever. We have this rotation where we try to concentrate the impacts. The tracts are on a very

long 50 year rotations because the animals live so long. It is a lot more like forestry than fishing—instead of picking out a tree here or there it is more like clear-cut. We are talking hundred-fifty-year life spans as opposed to the 10ish year quahog lifespan.

S: Are the harvesters required to work any volunteer hours?

H: No- that is not a thing we do.

S: How do harvesters feel about conservation? Do you have a good working relationship with them?

H: We have more direct contact with sea cucumber and sea urchin harvesters and it is a pretty good relationship. We have limited entry in those fisheries so there are only 25 licenses in the Puget Sound each – so it is a smaller group. We take some data from aboard their vessels and our fisheries managers spend a lot of time on the phone with them talking with them about what they are seeing. I think it is a pretty good relationship. The geoduck is different because there is so much separation between us and them and that is because the department of natural resources is also involved and that goes back to the fact that it is a bit more like mining or timber than a fishery. The geoducks and intertidal clams are really the only fishery where DNR gets involved. Geoducks are such a valuable resource and DNR is the land owner so they are involved in the leasing.

S: Are property lines to the high-water mark?

H: It depends. There is a lot of private ownership of the tidelands. It is a patchwork of private and state-owned lands. The DNR operates kind of like a timber sale. The highest bidder for a quota and a particular tract goes to the highest bidder. The buyers are then entered into a contract and are pre-paying for some of these pounds and then they are not even the harvesters themselves. They hold the contract and then hire the divers to get the geoducks. So, there are a lot of layers between me and harvesters so I don't get a lot of time interacting with them. Geoducks are limited entry and there are 77 licenses I believe. On the tribal side, they have a lot more interaction with their harvesters on a day to day basis. Whoever is a diver on that tribe gets their quota (they are still restricted to the tracts we have negotiated with them) and it is a much more similar basis to what you might be thinking about.

S: So, licenses are given out for separate species?

H: On the recreational side you can get a shellfish license and it covers most everything (there is a separate endorsement for crab) but that is about it. That is statewide. On the commercial side most of them are limited entry. One important thing to point out is that we don't really have a

commercial wild fishery for clams and oysters on the beach. The tribes do, but the state half is really all set aside for recreational harvest. On the tribal side almost all of the quota is set aside for commercial harvest. They don't call it recreational, they call it ceremonial and subsistence but it is equivalent. For geoducks both sides are commercial.

S: In terms of reporting is there a check on how many geoducks are actually harvested?

H: There is for geoducks in a major way because they are so valuable. There have been so many problems with poaching in the past so DNR has a compliance team, so does every tribe. Our agreements with the tribe say that there must be a monitor every day and every hour a tract is open. Someone is always watching. At the end of the day DNR or tribal monitor pulls up to every harvest vessel and weighs their product and records it. Then they are released and they can go back to the port and actually transfer it to the buyer. We have had some price problems, the market has actually collapsed right now, but in the past it was 10-15 dollars a pound and these are two pound animals on average so it is like diving around picking up 20 dollar bills.

S: How are the surveys conducted?

H: For geoducks we do scuba dive surveys and I think transects is the best term to use. They are six feet wide by 150 feet long each. A diver on each side for three feet each. We will do around 1 or less of those of those transects for an acre of the tract.

S: Do you think this survey method gives you an accurate picture of the population?

H: It's not bad. Our target precision level is + or – 30% by agreement with the tribes because we are sharing data. If you are in a very patchy variable tract you might need to do more transects to get that precision down below 30%. I think that piece of it is decent. Some of these tracts have millions of pounds so the + or – 30% might mean we are missing thousands of pounds of biomass. We try to be conservative so we usually have more than we expected. There is the problem that we need to do some dig sampling to get weights but for the most part we are only counting the siphons but that depends on how many siphons were showing that day. We are counting siphon tips and we do not know how many are likely to be up or down on a given day. We know there is a seasonal aspect to it but every year we tackle surveys that give us nonsensical results—the show (of the siphons) is the most likely culprit so we try to account for that by having areas where we do know exactly how many are there are we can make inferences from there--but it is something we are working on. We have time lapse cameras going but I would say it is a major problem.

H: The benefit of having the lucrative fishery is that it pays for all the DNR and Fish and Wildlife salaries that are fully supported by the fishery itself to do all the work. That is not the case on the beaches.

thanked interviewee for their time and ended interview