

The Impact of Maine's Municipal Shellfish Management on Clam Harvester Motivation to Participate in Resource Conservation

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ABSTRACT

Over the last decade, landings from one of Maine's most valuable marine resources, soft-shell clams, have declined due to environmental and social stressors. To address this challenge, some municipal shellfish committees have encouraged or required harvesters to participate in conservation activities, which are intended to help protect and grow the resource. However, harvester involvement varies, leaving resource managers wondering how they can increase participation. This study draws on interviews and a survey in four focal communities to examine harvester participation in conservation activities, their internal and external motivation to participate, and the factors that may influence those motivations. Findings indicate that conservation requirements and committees composed of harvesters are positively correlated to harvesters' intrinsic motivation to participate in formal conservation activities. These insights may help municipal and state agencies refine future shellfish conservation policies and recommendations.

the mudflats. Clamming's economic value and its relatively accessible entry for newcomers, paired with its declining harvests, make it an important industry to understand.

The soft-shell clam fishery is managed by individual municipalities and Maine's Department of Marine Resources (Maine DMR 2016). This relationship allows municipalities to assume management responsibility under the condition that they comply with certain state-level statutory and regulatory requirements. Additionally, each town must establish a shellfish conservation committee to work with DMR scientists to enact resource management regulations and tools. These actions include setting license quotas; es-

INTRODUCTION

The Gulf of Maine's fisheries and the jobs they spawn are an integral part of the culture of coastal Maine communities. Unfortunately, environmental changes, such as rising ocean temperatures, high predation rates, and shifting ocean chemistry (Pershing et al. 2021), as well as social changes, such as landowners restricting public access to private lands (Zoellick et al. 2023), are negatively affecting the marine resources that underpin these fisheries.

Maine's soft-shell clam fishery has been particularly hard hit by these changes. The commercial harvest of soft-shell clams has decreased by roughly 75 percent over the last 40 years (Beal et al. 2016). Still, in 2024, soft-shell clams were Maine's second most valuable fishery, bringing in a total of \$15,461,017 (Maine DMR 2025). Additionally, for residents of coastal communities, clamming remains one of Maine's few fisheries without a high financial barrier to entry. Beyond a license, the only equipment harvesters need are a rake, a basket, and some good boots for

establishing areas closed to digging; restricting the amount of time, the number of days, or the seasons people can harvest; and implementing harvester resource conservation activities. Municipalities also collect a range of data about the resource, including shellfish population surveys, landings data from shellfish wholesalers, harvester surveys, and public- or private-sector expert information (12 MRSA §6671).

Shellfish harvesters are often involved in conservation activities, including tasks like spreading clam seed on the mudflats, cleaning up trash, deploying predator-protection netting, building clam upwellers, and assisting in data collection. These activities can be required or voluntary, and there is a great diversity in the approaches shellfish committees and harvesters take to conserve their soft-shell clam populations. Because the number of shellfish harvesters and the price of licenses vary from town to town, the financial capacity of shellfish committees varies. Larger programs or those with higher license fees often have more money to spend on improving clam populations than smaller programs. However,

shellfish committees along the coast have had trouble ensuring the participation of their licensed harvesters in mudflat conservation efforts (Townsend 1985).

Motivating resource-users to participate in conservation activities can be complicated. Questions abound, including, “What motivates individuals to act altruistically in support of environmental conservation goals?” and “How can incentives positively or negatively influence these motivations?” To explore these questions in the context of Maine’s shellfish fishery, we study the intrinsic (i.e., internal) and extrinsic (i.e., external) motivations of shellfish harvesters and the role of external incentives and structures in motivating behavior. We apply the theory of *motivational crowding* to explore if extrinsic motivation structures (e.g., compensation or requirements) are having their desired effect of increasing participation (Frey and Jegen 2002). This research builds on previous studies that highlight how successful marine resource co-management depends not only on formal policies, but also on relational dynamics like sustained collaboration and trust between state agencies and municipal shellfish committees (Chivers et al. 2025; Risley et al. 2023, 2025).

Using expert interviews and a survey of harvesters in four Maine communities, we explore how extrinsic incentives and governance structures influence harvesters’ intrinsic motivation to participate in shellfish conservation activities. The case study towns present an opportunity to investigate how different governance strategies and conservation requirements relate to participation in and motivation for prescribed conservation activities.¹ This study may provide insights into why people engage in shellfish conservation efforts with their municipalities and how the structures of municipal governments’ management programs may be designed to maximize engagement.

MOTIVATIONAL CROWDING

Behavioral psychology and natural resource management can help us understand how different incentives and policies affect people’s motivation to conserve resources.

Intrinsic and Extrinsic Motivation

Motivation is often categorized as intrinsic or extrinsic. Intrinsic motivation arises from internal desires that are not dependent on external factors or rewards like compensation. Extrinsic motivation arises from external forces or incentives that drive the behaviors, such as the monetary value of a resource (Pittman and Heller 1987).

Although these two motivational categories are often represented as being mutually exclusive, evidence shows they can be held simultaneously and people can fluidly attribute different kinds of value to the services their environments provide (Arias-Arévalo et al. 2017).

In the context of natural resource management, extrinsic motivation means protecting the environment to get something in return, like using resources, receiving payments, or avoiding penalties. Intrinsic motivation, on the other hand, means caring for nature because you value its spiritual, cultural, aesthetic, or ecological importance (Arias-Arévalo et al. 2017). Communities whose resource-based economies and cultural norms involve close interactions with their natural environments often show heightened intrinsic values and conservation ethics (Torres et al. 2016). Their frequent contact with and subsistence use of local resources prompts these groups to deeply value their environment’s ability to provide material and nonmaterial life-sustaining services (Daigle et al. 2019). While extrinsic and intrinsic values can, and do, work together to motivate a person to act, prioritizing the cultivation of intrinsic motivation in a group can lead to more willing participation in selfless actions (Akers and Yasué 2019).

Motivational Crowding

The interaction between intrinsic and extrinsic value types has largely been explained by the motivational crowding effect. This theoretical framework suggests that “external intervention via monetary incentives or punishments may undermine, and under different identifiable conditions, strengthen intrinsic motivation” (Frey and Jegen 2002: 589). Motivational degradation can result from people shifting their intrinsic motives to engage in conservation (influenced by altruism and moral responsibility) to extrinsic motives (prompted by self-serving, material reasons). External incentives tend to diminish or “crowd out” intrinsic motivation if individuals feel their freedom of choice and self-esteem are impaired. This is often associated with groups who may feel condescended to by regulating bodies or are given little say in the process of instituting new policy that dictates their interactions with the surrounding environment (Tremblay et al. 2009). Conversely, the intrinsic motivation to act in pursuit of collective well-being can be reinforced or “crowded in” when constituents feel their “competence, autonomy and relatedness” are prioritized by the incentive-based policy (Ryan and Deci 2000: 68).

The effect of motivational crowding on preferences can also be influenced by the way an incentive is implemented. Programs where the administrators (1) provide information about the intentions of the incentive, (2) frame decisions in a way that outlines appropriate behavior, (3) maintain an individual’s sense of autonomy, and (4) examine the process by which groups learn new preferences can minimize motivational crowding-out and make incentives and social preferences complementary (Bowles and Polania-Reyes 2012). In practice, this can take the form of local leadership making transparent decisions and including procedural justice concepts like community-engaged policy planning. When clear communication, inclusion, and respect are upheld in an external policy implementation process, constituents’ intrinsic motivations to contribute to the overarching goals is much more likely to be upheld (McGreavy 2023).

Research Opportunity

Drawing on existing research about Maine’s shellfisheries (e.g., Farr 2018; Hillyer 2023; McGreavy et al. 2018, 2023), this study applies motivational crowding theory to explore the relationship among governance structures, incentives, and harvester motivation to participate in conservation activities. With the guidance of key informants, the central research questions are

- 1. How does the composition and management structure of Maine’s regional shellfish committees influence harvesters’ willingness to participate in shellfish conservation efforts?
- 2. Have externally imposed policy measures reinforced or degraded Maine’s shellfish community’s intrinsic motivation to contribute to environmental conservation efforts?

Building on these research questions, we offer the following hypotheses:

- 1. Towns with required shellfish conservation hours are negatively associated with licensed harvesters’ intrinsic motivations to participate in mudflat conservation activities.
- 2. Towns with shellfish committees made up of licensed shellfish harvesters have a positive relationship with their harvesters’ intrinsic motivations to participate in mudflat conservation activities.

The first hypothesis is rooted in literature about motivational crowding theory and its prediction that requiring acts of environmental altruism can decrease intrinsic motivations to participate in conservation activities (Akers and Yasué 2019; Tremblay et al. 2009). The second hypothesis is supported by previous studies claiming that including local community members in the governing process can help align values to increase intrinsic motivation to act pro-environmentally (Bowles and Polania-Reyes 2012; Rode 2015).

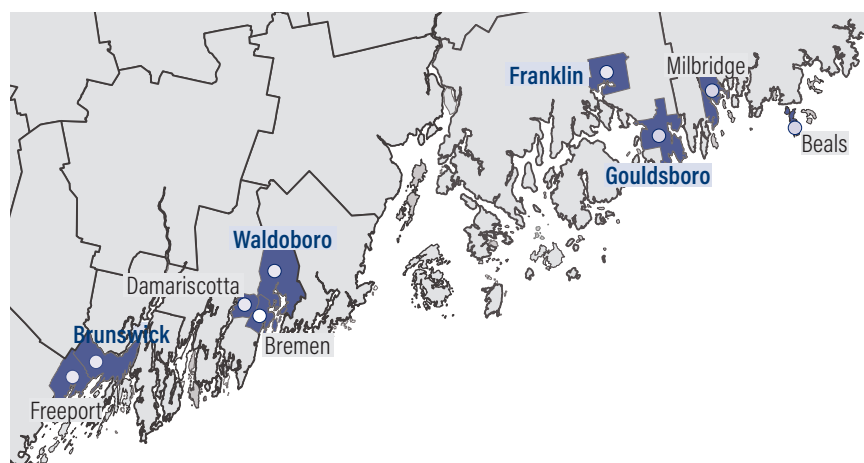
METHODS

Employing an iterative approach to research design, we began with key informant interviews, followed by observations at a selection of shellfish committee meetings, and concluded with a survey of shellfish harvesters (Table 1). Each phase of the process informed the direction of the next research stage.

We worked alongside stakeholders to cocreate research questions that served the communities with which we interacted in “an ongoing process of exchange with the aim of establishing and maintaining equality between parties” (Maiter et al. 2008: 321). With guidance from collaborators at the University of Maine and Maine’s DMR, we developed a list of key informant interviewees geographically spread across the Gulf of Maine (Figure 1).

TABLE 1: Methods Summary

Research design
Key informant interviews and observations
Cocreating research questions
25 semistructured interviews
6 shellfish meeting observations
Interview summary transcripts
Response coding
Shellfish harvester survey
12 questions
50 harvester responses
4 towns represented in sample
Statistical regression analysis

Figure 1: Locations of Key Informant Interviews

Note: Bold blue font highlights the four survey case study towns.

Key Informant Interviews

We conducted face-to-face interviews with 25 key informants. Of these key informants, six were harvester shellfish committee members, five were DMR scientists, four were from nonprofit or research organizations, four were shellfish wardens, three were nonharvester shellfish committee members, and three were municipal leaders. We also observed six shellfish committee meetings in fall 2023. The interviews were guided by three unique, semi-structured interview protocols: one for academics, nonprofit, and DMR-associated informants; a second for shellfish committee and municipal representatives; and a third for shellfish harvesters. Each protocol was designed to offer interviewees the space to share information about their lived experience with the shellfish management system (Patton 2002; Seidman 2006). Specifically, the protocols asked participants about (1) general interviewee demographics, (2) specific town ordinances and leadership structures, (3) observations of and experiences with harvester participation in conservation, (4) suggestions about ways to improve our research, and (5) questions they would like to ask on a survey. After processing the fieldnotes and rough interview transcripts, we coded them to quantify trends in the responses to four of the most relevant interview questions (Patton 2002).

Municipal Shellfish Conservation Program Case Studies

Although there are currently 58 municipal shellfish conservation programs registered with the DMR in Maine,

the scope of this study focuses on four municipal ordinances and their approaches to engaging with clam license holders in industry-related conservation activities. We selected these case study communities because they were willing to participate in this research and would provide a diverse range of municipal shellfish ordinances with different policy approaches to encourage conservation participation. Table 2 outlines the structure of each shellfish conservation committee and their respective conservation policies.

Each community uses different strategies to encourage participation in conservation. For example, Brunswick and Gouldsboro require harvesters to complete mandatory conservation hours for their annual license renewal, with some option to pay extra to make up for the hours not completed (Singer 2022). In contrast, Frenchman's Bay Regional and Waldoboro make conservation hours optional with incentive payments for the hours harvesters spend in shellfish-committee-sponsored conservation activities.

Finally, these programs also have different requirements for the number of licensed harvesters on their shellfish committees. Gouldsboro's and Frenchman's Bay's committees are currently composed exclusively of licensed harvesters, while Brunswick's and Waldoboro's committees include nonharvesters and harvesters. Frenchman's Bay is the only municipality in this study that requires committee members to be licensed harvesters (FBRSCC 2022). Differences across programs gave us a unique opportunity to study the impact of conservation hour requirements and harvester committee leadership on harvesters' motivation to participate in conservation activities.

Shellfish Harvester Survey

The harvester survey examined clam harvester experiences with and motivation to engage in conservation activities. The 12-question survey consisted of three sections: (1) demographics, (2) values, and (3) free-response questions. One set of questions investigated the motivation for resource stewardship and the perceived efficacy of available conservation activities. The results of our

TABLE 2: Summary of Municipal Shellfish Committee Compositions and Conservation Requirements in 2022

	Brunswick	Gouldsboro	Frenchman's Bay	Waldoboro
Total commercial license holders	80	9	60	160
Total committee size	7 (+2 alt)	5	7	9
Harvester committee representatives	4	5	7	Majority
Nonharvester committee representatives	3	0	0	Minority
Total conservation hours requirement	10	10	0	0
Fieldwork requirement	Max 2 activities	7 hrs	Voluntary	Voluntary
Meeting requirement	Max 5	3	Voluntary	Voluntary
Option to pay for conservation	\$100 per hr	n/a	n/a	n/a
Option for license fee reduction	No option	No option	Max 12 hrs for \$15/hr reduction	Max 6 hrs for \$10/hr reduction

interviews informed the content and language we used in the survey, which we field tested prior to its full implementation.

The surveys were administered as (1) paper surveys given out at in-person shellfish committee meetings and (2) online surveys sent to harvester email lists (lists provided by shellfish committee leaders and DMR scientists). We received 50 responses in total (N=50). As expected, response levels were higher at in-person meetings. Table 3 describes survey administration by town and the associated response yield. Regardless of format, each town yielded a similar number of responses.

Statistical Analysis

Using STATA, we ran univariate descriptive statistics to summarize all responses and then generated cross-tabulations to sort responses by town. The tabulations allowed us to investigate if the variation in harvester opinion was significantly associated with their

respective ordinance and shellfish committee. Specific survey responses corresponded to different motivation types—either intrinsic or extrinsic. We used these indicators to assess the frequency with which harvesters from each town selected each type of motivation. We then performed two bivariate correlation tests to investigate both research questions. These tests supported a regression analysis using logistic and Poisson models to test the hypotheses.

RESULTS

Interview Analysis

Three main findings emerged from the key informant interviews. First, interviewees expressed concerns that harvesters were not engaging in conservation activities often enough for the shellfish committee leaders to feel supported in their efforts to improve clam yields. Second, there were varying opinions across the study sites about the efficacy of the conservation activities offered by shellfish committees. Third, interviewees identified factors they thought were positively associated with the successful implementation of the comanagement program.

In relation to participation in conservation activities, 80 percent of interviewees expressed that shellfish harvesters “never or rarely” practice acts of mudflat stewardship outside of the formalized activities organized by their towns. Some interviewees theorized that harvesters prefer to spend any available time on the mud digging for clams to sell. Interviewees asserted that there is a clear common pool resource problem (Ostrom 2008) associated with clam conservation. According to one harvester, there is a

TABLE 3: Methods of Survey Administration by Town

Town	Method	Administered at committee meeting	Total respondents
Brunswick*	Online	Yes	11
Gouldsboro	In-person	Yes	11
Frenchman's Bay	In-person	Yes	12
Waldoboro	Online	No	16

*Brunswick harvesters were given the opportunity to complete it online via a QR code displayed at the harvester meeting or via the paper survey that was also available at the meeting.

belief that if “you don’t dig it, someone else will.” That is, if clams are left in the mud to conserve the population in a particular cove, they will just be dug by someone else, negating any positive effect of reducing one’s personal clamming effort.

A DMR representative also theorized that harvesters may not be motivated to engage in conservation activities because the benefits of certain conservation actions are uncertain: “every town is different, and every program is different....Many shellfish conservation events are not successful or are not monitored for success, so we don’t really know if these measures are putting more clams in the mud.” According to several DMR scientists we interviewed, soft-shell clam populations in different regions also respond differently to various conservation activities. Based on years of trying different conservation strategies to improve shellfish populations, harvesters and marine scientists both admit that there is no single proven solution that works across the Gulf of Maine. One DMR scientist emphasized that the scientists “aren’t here to tell towns the best tools to use, because every town and cove is different every year.” When asked about conservation participation, one committee member stated, “What is a DMR scientist going to tell us that is new? We have been doing this for years.”

In terms of perceived effectiveness, many conservation projects sponsored by a town’s shellfish committee are experimental, as there has been limited review of the impact of each kind of conservation action on clam populations. Research on one popular conservation technique, brushing,² showed that it may not actually increase the settlement of clam seed given the increasing rates of predation (Beal 2020). Harvesters may be discouraged by the lack of tangible results from their work. According to one harvester we interviewed, harvesters “would be beating down the door” to get involved if the conservation activities “were actually doing anything.”

With the unpredictability of weather patterns, predation, and clam seed uptake, soft-shell clam population levels have also been inconsistent, leading to further skepticism about effectiveness of conservation actions. For example, a harvester in Waldoboro stated, “I’ve seen every cove in this river flourish and every cove in the river die, there is no pattern.” When referring to “cove,” the interviewee is referencing the different mudflats where they go clamming around their hometown.

Finally, interviewees identified several factors they associate with successful shellfish conservation programs,

including having shellfish committees that are harvester-led (n=9), ample access to funding (n=6), and highly active shellfish wardens (n=6). According to one DMR scientist “too much emphasis is placed on conservation, when it is really the existence of the program that makes the biggest difference.” This statement reiterates that just having a structured system to organize the soft-shell clam fishery at the local level may be the biggest step municipalities can take for resource conservation in the long run.

General Survey Response Analysis

The average harvester age of survey respondents was 47.5 years, with a minimum age of 19 and a maximum of 72. Brunswick had the youngest average age (34), while Gouldsboro had the oldest average age (57). Forty-eight percent of respondents reported that clamming was their main source of income while 36 percent said it was not. Alternatively, 16 percent reported that their financial reliance on the soft-shell clam fishery depended on the season. When asked about participation in shellfish committee meetings, Gouldsboro had the highest average participation in shellfish meetings with approximately five meetings per year per harvester. Frenchman’s Bay averaged four meetings per year per harvester, Brunswick averaged three meetings per year per harvester, and Waldoboro averaged 1.4 meetings per year per harvester.

While Gouldsboro requires licensed harvesters to attend at least three meetings per year, Gouldsboro harvesters participated in about five official meetings each year. Town representatives noted that since Gouldsboro only has nine licensed harvesters, there are fewer voices in the room and each person’s opinion is heard and matters proportionally more. These factors could be positively influencing the attendance rates of Gouldsboro harvesters at meetings.

When asked about the type of stewardship actions they participate in, 68 percent of respondents reported they engage with manual fieldwork to support conservation projects, and 60 percent reported that they replant small clams in the mudflat so they have time to mature and reproduce. “Saving clams to dig later” and “clamming less when the price is lower” were also popular tactics harvesters associated with mudflat stewardship, with 56 percent and 42 percent of respondents reporting their participation in these actions, respectively. Respondents also mentioned that reporting others clamming without a license or not following closure guidelines is a form of resource and ecosystem stewardship.

TABLE 4: **Perceived Efficacy of Shellfish Conservation Activities, by Town**

	Waldoboro	Frenchman's Bay	Brunswick	Gouldsboro	Overall
Faulty septic identification*	2.4 (1.06)	3.36 (1.86)	3.90 (0.99)	3.45 (1.21)	3.19 (1.39)
Seeding*	2.45 (0.92)	3.09 (1.51)	3.64 (0.92)	3.40 (0.70)	3.09 (1.12)
Attending meetings**	2.27 (0.59)	3.73 (1.62)	2.82 (0.98)	3.10 (0.74)	2.91 (1.14)
Population surveys	3.00 (0.82)	3.50 (1.58)	2.91 (0.94)	2.29 (0.82)	2.87 (1.12)
Beach clean-ups	2.53 (0.74)	3.33 (1.37)	2.64 (1.07)	3.00 (0.45)	2.86 (0.99)
Trapping crabs**	2.2 (0.56)	3.36 (1.03)	2.90 (1.10)	3.18 (0.41)	2.85 (0.91)
Experimental projects	2.43 (0.51)	3.00 (1.41)	3.09 (1.12)	2.91 (1.04)	2.82 (0.99)
Predator netting	2.29 (0.83)	2.75 (1.54)	2.7 (0.48)	3.45 (0.93)	2.77 (1.09)
Water surveys	2.47 (1.13)	2.58 (1.44)	3.09 (0.94)	3.00 (0.47)	2.75 (1.08)
Brushing**	2.00 (0.00)	3.09 (1.45)	2.88 (0.99)	3.27 (0.65)	2.75 (1.01)
Town avg. across all activities	2.40	3.17	3.01	3.11	2.89

Note: (N=50); 1 = negative, 2 = none, 3 = slight positive, 4 = moderately positive, 5 = very positive.
ANOVA test for significant differences between town averages: * = $p < 0.05$, ** = $p < 0.01$

In answer to a question about which sources of information harvesters use to judge the health of the mudflat, 86 percent of respondents cited “personal observations” and 90 percent cited “knowledge accumulated over time” as significant sources of information. Forty-two percent of harvesters relied on the observations of other harvesters for judging mudflat health. Fewer than 20 percent of harvesters reported using DMR, shellfish committee or town leadership, and landings data to assist with their assessment of mudflat health.

While the majority of survey respondents (64 percent) perceived conservation requirements as having positive effects on the resource, 40 percent of those individuals reported the positive effect as slightly rather than moderately or very positive (Table 4). The activities perceived as most effective included “identifying faulty septic systems” and “seeding.” Both of these conservation actions directly affect the volume of harvestable clams, which is financially beneficial to diggers. Faulty septic systems may cause mudflat closures due to contamination,

so finding point sources of pollution can directly affect harvesters’ access to clams (Evans 2016), and spreading clam seed increases the likelihood that clams will grow big enough to harvest. From Table 4 we can also see that fewer respondents perceive there to be a positive impact from activities associated with the assessment of mudflat conditions, like performing water or population surveys. Similarly, predator protection actions, like crab trapping or placing protective netting, are not seen as particularly effective; they can be difficult to maintain and are an unreliable method for improving landings.

It is also interesting that there are different perceptions of the efficacy of conservation activities between towns. For example, overall, respondents from Frenchman’s Bay, Gouldsboro, and Brunswick reported that conservation activities have a “slightly positive” to “moderately positive” impact on the fishery and mudflat ecosystem (means above 3.0), whereas Waldoboro perceived conservation activities as having a negligible to “slightly positive” effect with a mean rating of 2.4 (Table 4).

Motivational Survey Response Analysis

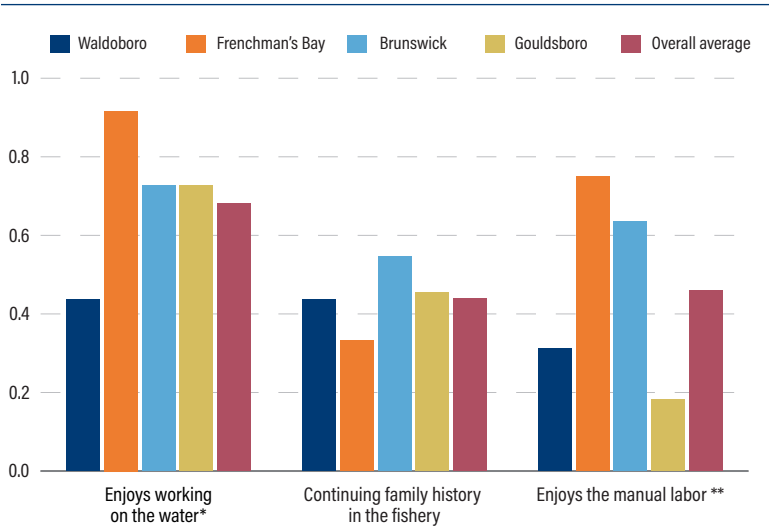
To explore harvester motivation to participate in mudflat conservation efforts by intrinsic and extrinsic motivations and by town, we asked two questions: “Why were you originally drawn to get your clamming license?” and “What factors influence your decision to participate in conservation activities?” We used survey prompts to evaluate different values harvesters hold for their industry. Across questions, the following responses measured intrinsic motivation: (1) enjoys being on the water, (2) continuing family history in the industry, (3) enjoys hard labor, (4) intergenerational considerations, (5) respect for clams as a marine resource, (6) respect for the culture and history of clamming, and (7) general community/industry benefit. Extrinsic motivation was measured using the following responses: (1) immediate income, (2) future income, and (3) required hours. Figures 2, 3, and 4 summarize response frequencies for intrinsic and extrinsic motivation items.

As can be seen in Figure 2, harvesters from all towns hold preexisting intrinsic motivations to hold a clamming license, with “enjoying working on the water” having the highest overall frequency. Respondents from Frenchman’s Bay and Brunswick exhibited the strongest intrinsic motivation to get a clamming license, and Waldoboro respondents reported the lowest level of intrinsic motivation.

Frenchman’s Bay and Brunswick’s respondents were also above the overall average on three out of four intrinsic motivation items addressing what motivates their participation in conservation activities (Figure 3). “Respect for clams as a resource” and “respect for the culture and history of clamming” were the most commonly reported intrinsically motivated reasons for participating in conservation activities. “General industry/community benefit” was significantly more important to harvesters in Frenchman’s Bay and Brunswick than to those in Waldoboro and Gouldsboro.

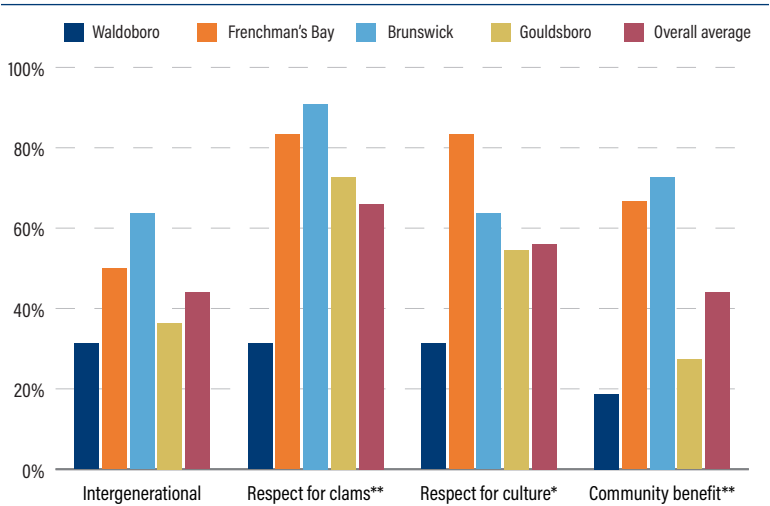
We then examined extrinsic motivation for participating in conservation actions (Figure 4). When asked what motivated harvesters to participate in conservation

FIGURE 2: Frequency of Harvesters’ Intrinsic Motivations for Clamming License by Town



Note: (N=50); ANOVA test for significant differences between town averages: * = $p < 0.05$, ** = $p < 0.01$.

FIGURE 3: Frequency of Harvesters’ Intrinsic Motivations for Conservation Activities by Town



Note: (N=50); ANOVA test for significant differences between town averages: * = $p < 0.05$, ** = $p < 0.01$.

activities, 52 percent of respondents selected “future personal income” as the most influential external motivator. Only 24 percent of respondents chose “required hours”; however, 54 percent of respondents from Brunswick cited “because it’s mandatory” as the primary driver for participating in conservation activities, a much higher percentage than was reported in other communities. None of

FIGURE 4: **Frequency of Harvesters' Extrinsic Motivations for Conservation Activities by Town**



Note: (N=50); Note: (N=50); ANOVA test for significant differences between town averages (none).

the mean differences between town-level responses to the external motivation items were statistically significant, perhaps because of the small sample size.

Analysis

We investigated the relationship between towns with required conservation hours and their harvesters' reports of intrinsic motivation. Out of the seven intrinsic motivation indicator variables, all but one were positively associated with towns that required hours of service. These results seem to contradict our original hypothesis that mandatory conservation hours would crowd-out intrinsic motivation to steward the mudflat and clam populations. Additionally, five out of seven of the intrinsic motivation indicators were positively correlated with harvester-run shellfish committees. These findings support our original hypothesis that shellfish committees made up of licensed shellfish harvesters encourage the expression of intrinsic motivations to conserve the resource.

We then ran several statistical regression models to test the influence of multiple factors at once (town hours requirements, towns with total harvester committee leadership, and age) on each of the intrinsic motivation indicators. These models estimate the effect of each factor on the intrinsic motivation variables, independent of the other factors, and are the most accurate way to judge these associations. The first two independent variables test the study hypotheses, and we added age as a control variable in case generational differences could

influence harvester motivations. It is important to acknowledge that this study's sample size is limited, so most of the statistical results only suggest associations.

The hours requirements factor had the strongest association with the intrinsic motivation indicator, respect for clams, followed by the family history intrinsic motivation indicator.³ The harvester committee representation factor also had positive associations with the following intrinsic value indicators: respect for clams, respect for culture, and working on the water.⁴ The results also suggest a positive relationship between required conservation hours and the total number of intrinsic motivation indicators that were positively reported. Additionally, our findings suggest that having a shellfish committee completely made up of active harvesters may more positively influence the retention and reinforcement of harvesters' intrinsic motivation

to conserve the shellfish resource than a committee with a mixture of harvesters and nonharvesters.

We then looked at age as a final independent variable and found it had a negligible impact on how harvesters express intrinsic motivation to participate in conservation. We recognize, however, the influence of age and generational differences in this study may be underestimated due to survivorship bias (i.e., an error in which attention is paid only to those who have passed through a selective filter) in the survey sampling methods (Eldridge n.d.). In this case, a more motivated subset of harvesters may have self-selected to take part in shellfish management discussions more broadly. These individuals may also have been more likely to fill out our survey, thereby introducing the possibility that intrinsic motivation is overestimated in our results. Since the sample of survey respondents is skewed to overrepresent older members of the harvester community, it could have had an impact on how age influenced the models.

DISCUSSION

This study suggests that mandating conservation activities, such as hour requirements, does not negatively affect harvesters' intrinsic motivation to participate in these activities. Additionally, the results show that shellfish committees made up completely of harvesters may increase harvesters' intrinsic motivation to participate in

conservation activities. Respondents more often reported being motivated to participate in conservation by their intrinsic value for the clam fishery rather than by external motivations.

While these study results are academically interesting, we can also offer several pragmatic suggestions for policymakers and fisheries leaders. These suggestions include better linking local and scientific expertise, improving scientific research on the effectiveness of conservation activities, creating a system where required conservation actions clearly align with the communicated goal of improving clam landings, and strengthening harvester leadership on governance committees. Here we identify mechanisms for doing so.

Integrate Local and Scientific Expertise

The study revealed that respondents judge the health of the mudflat based on their personal knowledge and current observations more than on sources like Maine's DMR. Yet, Maine's DMR and other environmental organizations are likely to conduct scientific studies on the effectiveness of conservation activities on improving mudflat health. While DMR scientists are well aware of clammers' skepticism about the science of shellfish conservation and are attempting to build better relationships within the harvester community, scientists should work as much as possible with the harvester community to co-produce such studies. The Damariscotta River Estuary project documented how research involving both scientists and municipalities fostered trust, improved ecological outcomes, and enhanced community ownership over data and decision-making (Risley et al. 2023). Given that harvesters trust their own knowledge and experience above other sources of information, fisheries managers should speak frequently with harvesters about their experiences and the trends they are seeing on the mudflats. If harvesters see their voices reflected in reports and policy decisions, they may have higher trust in them (McGreavy et al. 2023).

One way to better align external motivators to reinforce intrinsic motivation to participate in conservation could be to focus conservation hour requirements on activities that harvesters perceive to be the most effective, as long as these activities are supported by scientific studies. This would allow licensed clammers to feel more confident that their mandated contribution to conservation is aligned with both their personal and community-level goals to increase clam populations, and therefore, landings.

Increase Scientific Research on Conservation Activity Effectiveness

More scientific research is needed to demonstrate the degree to which conservation activities contribute to increasing local shellfish populations and landings. With clear information about the direct effects these activities have on increasing clam populations and landings, harvesters may be reassured that the hours spent stewarding the mudflat are worthwhile. However, as we heard from many key interviewees, "word of mouth is the best way with these guys." Thus, shellfish comanagement in Maine may benefit from more community science approaches that center local knowledge and direct harvester involvement.

Better Align Incentives with Conservation Goals

Shellfish committees may have success increasing harvester willingness to participate if conservation activities better align with the expressed intention of the conservation actions. For example, committees may continue to require that harvesters perform a certain number of conservation hours to renew their licenses, but these credited activities should be focused on promoting population growth (i.e., seeding, predator protection). Focusing on such conservation actions may improve the connection between the required activities and the goal of improving shellfish landings—a goal of both harvesters and shellfish committees. Contributing more broadly to the shellfish community (i.e., shore cleanups, meeting attendance, teaching, and landowner outreach) is still essential to building community relations and maintaining place-based knowledge. Connecting these actions to soft-shell clam population growth needs additional research.

Strengthen Harvester Leadership in Municipal Governance

As noted earlier, harvester observations serve as a trusted information source for most diggers. Thus, increasing the number of harvesters in leadership positions on shellfish committees may improve confidence in the efficacy of recommended conservation activities. Shellfish committees entirely composed of licensed harvesters may have a positive relationship with harvesters' intrinsic motivation to take part in the conservation activities prescribed by leadership. Peer representation on committees may help harvesters feel heard and included in decision-making, which in turn may help them feel more intrinsically motivated to comply with committee

recommendations and requirements (Ryan and Deci 2000). This finding introduces the new challenge of motivating harvesters to take on leadership roles, which further research can also explore.

Limitations

There are limitations to consider when thinking about applying the results of this study. First, the average age of respondents was 47.5 years, and there was a significant difference in the average age between towns. Age could be a confounding factor in our analysis. Second, there was variation across respondents in the proportion of income from clamming. Harvesters who rely on clamming as their main source of income might hold the most value for the resource and express the most motivation to participate in conservation. Given that a third of respondents do not rely on clamming as a main source of income, this study may underestimate the strength of the relationship between intrinsic motivation and conservation.

Third, the survey methods have potential limitations. While the online format allowed for anonymity, the in-person surveys were collected by the shellfish committee leaders and returned via mail. Harvesters may not have expressed their most authentic opinions on the paper survey because of the lack of anonymity. The time allotted during meetings for filling out the survey also varied between shellfish committees, which could have influenced the depth of responses included in the open-response questions. It is also notable that respondents were already representative of a more involved subgroup of harvesters who attend meetings or respond to shellfish committee requests.

Finally, the license structure established by the shellfish comanagement system, also, often denies mudflat access to indigenous Wabanaki people, who have relied on clamming throughout Maine's coast for centuries, because they may not meet resident requirements (MITSC 2023; Pawling 2016). Although beyond the scope of this research, these access issues and views of Wabanaki harvesters deserve further consideration.

CONCLUSION

This study suggests that conservation activity requirements are a productive method to protect intrinsic value for the culture of clamming and clams as a resource while also encouraging participation in this fishery's sustainable management. However, to ensure commitment and engagement, more needs to be done to document the efficacy of these conservation efforts. Given that comanagement success is often shaped by trust-building efforts between resource users and resource managers (Risley et al. 2023, 2025), encouraging more overlap between the two in municipality-led shellfish committees may help address skepticism of conservation activities and deepen harvester engagement.

As policy measures can only go so far in influencing community buy-in, further research into why people choose to act altruistically towards their natural environment is valuable for strategic planning around large scale goals of responsible resource use in Maine's fisheries. Because each community on Maine's coast has unique human, financial, and ecological conditions, one governance strategy is unlikely to fit all. To further understand why and how harvesters and other resource users are "showing up to sustain this way of life now and for future generations" (McGreavy et al. 2023), community-engaged studies can help build a suite of effective conservation policies that can be adapted to fit each community. Luckily, in Maine's coastal communities, we have many examples of resource stewardship to guide us.

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NOTES

- 1 Since this research, Waldoboro has changed their conservation requirements. License applicants are required to complete conservation work and/or pay for conservation hours at \$12.75/hr up 6 hrs of conservation work. Conservation fees support the town's conservation fund
- 2 Brushing involves forcing recently cut white spruce boughs vertically into a mudflat in an effort to slow tidal currents and create eddies that help clams from being transported away from the flat (Beal et al. 2020).
- 3 Respect for clams ($\beta = 3.36$, $p = 0.12$); family history ($\beta = 1.99$, $p = 0.27$).
- 4 Respect for clams ($\beta = 4.41$, $p = 0.08$); respect for culture ($\beta = 4.78$, $p = 0.05$); working on the water ($\beta = 3.41$, $p = 0.13$)

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