

# MAINE & NEW HAMPSHIRE COASTAL RESIDENT SURVEY: **TECHNICAL REPORT**



Emma Fox, Caroline L. Noblet, Kathleen P. Bell, J. Ross Anthony, Abigail Kaminski,  
Margaret Snell, and Angela Hallowell



**SCHOOL OF ECONOMICS**

**Staff Paper # 627**



## ACKNOWLEDGEMENTS

The New England Sustainability Consortium (NEST) Safe Beaches and Shellfish Project is funded by National Science Foundation Award 11A-1330691 to Maine EPSCoR at the University of Maine. We thank NSF EPSCoR, and Maine EPSCoR for their support of this research. Further, the research team would like to acknowledge the key role of colleagues and collaborators in the design of the Maine and New Hampshire Coastal Resident Survey. Many of our questions are a direct response to question and information needs of key stakeholders, as well as emerging research questions about beach recreation, shellfish consumption, water quality, public health risks, beach management, shellfish growing area management, and environmental change. We thank numerous coastal stakeholders, collaborating researchers on the New England Sustainability Consortium (NEST) Safe Beaches and Shellfish Project, as well as colleagues involved with similar research projects nationally, for their excellent feedback.



## TABLE OF CONTENTS

<b>Executive Summary</b> .....	<b>3</b>
<b>Introduction</b> .....	<b>4</b>
<b>Survey Administration and Methods</b> .....	<b>5</b>
A. What information did we try to capture?	
B. Who participated in the study?	
C. How did we analyze our data?	
<b>Study Findings</b> .....	<b>8</b>
A. Coastal Water Quality	
B. Information, Water Quality, and Coastal Activities	
C. Economic Valuation	
<b>Discussion</b> .....	<b>20</b>
<b>References</b> .....	<b>22</b>



## EXECUTIVE SUMMARY

This report summarizes findings from the 2015 Maine and New Hampshire Coastal Resident Survey. The purpose of the survey was to gather information on the human dimensions of water quality: the survey investigated benefits associated with coastal water quality and focused on capturing economic and social values for this natural resource. We captured coastal residents' perceptions about water quality including benefits of water that is clear of pollution and free from contaminants, what factors detract from coastal water quality, as well resident beliefs about who is responsible for managing the resource and who manages the resource effectively.

### Key findings include:

- Nearly 57 percent of respondents are willing to contribute, via an increase in monthly water/sewer/septic fees, to a hypothetical Coastal Water Quality Improvement Program.
  - Factors that appear to increase a citizen's willingness to contribute include: trust in science (based on responses to a series of 7 questions) and participation in coastal recreation.
  - Residents who believe that state residents are responsible for helping to solve coastal water quality problems are more likely to express a willingness to contribute. Further, residents who believe that water quality is impacted by changes in their personal behavior or changes in their neighbors' behavior are more likely to express a willingness to contribute.
  - Factors that decrease willingness to contribute include: higher monthly fee, a higher rating of home- state water quality on a Likert scale, longer length of residency.
- Maine residents and New Hampshire residents evaluate water quality differently—New Hampshire residents provide higher rankings for water quality in all other states and provinces evaluated (including New Hampshire and Maine), where Mainers consistently assign lower coastal water quality rankings to their home state and to New Hampshire.
- Public health information seeking and reporting behavior may be an issue for citizens: although beach safety information is publicly available, 81 percent of respondents do not ever seek information on beach safety, and 70 percent of respondents do not ever seek information on shellfish consumption safety; further, of respondents who reported feeling ill (non-allergic) after eating shellfish, 80 percent did *not* report their (non-allergic) illness.
- Citizens rank pollution and runoff issues highest in terms of perceived negative impact on water quality. Examples of these issues are: industrial pollution; fertilizers, chemicals, pesticides; polluted river/stream runoff; and failing septic systems.
- Though most respondents believe that state residents are responsible for helping to solve coastal problems (79%), fewer believe it is their *personal* responsibility to help solve coastal problems (65%).

## INTRODUCTION

The connection between coastal water quality and public health is well-documented. As increases in tourism bring more visitors to the Maine and New Hampshire coastlines, water quality becomes an increasingly serious public health issue—more opportunities for exposure to water or potential for consumption of unsafe seafood is worrisome for coastal managers. The Maine and New Hampshire Coastal Resident survey is a part of a larger research effort through the New England Sustainability Consortium (NEST) Beaches and Shellfish Project<sup>1</sup> to address possible information gaps, support the information needs of coastal managers, and provide scientific information to inform policy assessment and design. The survey focused on valuation of coastal water quality, decisions about budget allocation, as well as perceptions and behaviors of Maine and New Hampshire residents relating to water quality, including possible water quality myths.

The goals of this survey were to:

- Identify resident priorities for coastal management, resident understanding of factors contributing to poor (and good) water quality, and resident evaluation of the consequences of impaired (and improved) waters
- Gauge resident acceptance of popular water quality myths such as improved water quality near freshwater inputs or after heavy rainfall
- Classify attitudes about local and state government agencies: trust in government, effectiveness of government to address coastal issues, as well as personal and governmental responsibility toward water quality, and effectiveness of government management
- Assess residents' willingness to pay to help improve coastal water quality, as well as budget allocation decisions
- Capture how personal characteristics of the individual—including climate change beliefs, trust in science, risky behaviors, and perception of risk—may influence knowledge about coastal water quality
- Provide insight and context to help improve alignment of management practices with resident perspectives for improved policy effectiveness

---

<sup>1</sup> The New England Sustainability Consortium (NEST) Safe Beaches and Shellfish Project is a collaboration between The University of Maine, University of New Hampshire, University of Southern Maine, University of New England, Plymouth State, and College of the Atlantic, funded by NSF-EPSCoR. You can learn more about NEST here: <http://nest.maine.edu/>, and here: <http://www.newenglandsustainabilityconsortium.org/safe-beaches-shellfish>.

## SURVEY ADMINISTRATION AND METHODS

The NEST Maine and New Hampshire Coastal Resident Survey was administered in August 2015. The sample area for the survey was New Hampshire and Maine's shared coast. Towns were selected for inclusion in the survey if they were defined as part of their respective state's *coastal zone* (Figure 1); this yielded 146 coastal towns in Maine<sup>2</sup> and 37 coastal towns in New Hampshire<sup>3</sup>. Participants received a letter by U.S. mail notifying them of their selection into the survey sample and inviting their participation, and received a survey booklet through U.S. mail shortly thereafter.

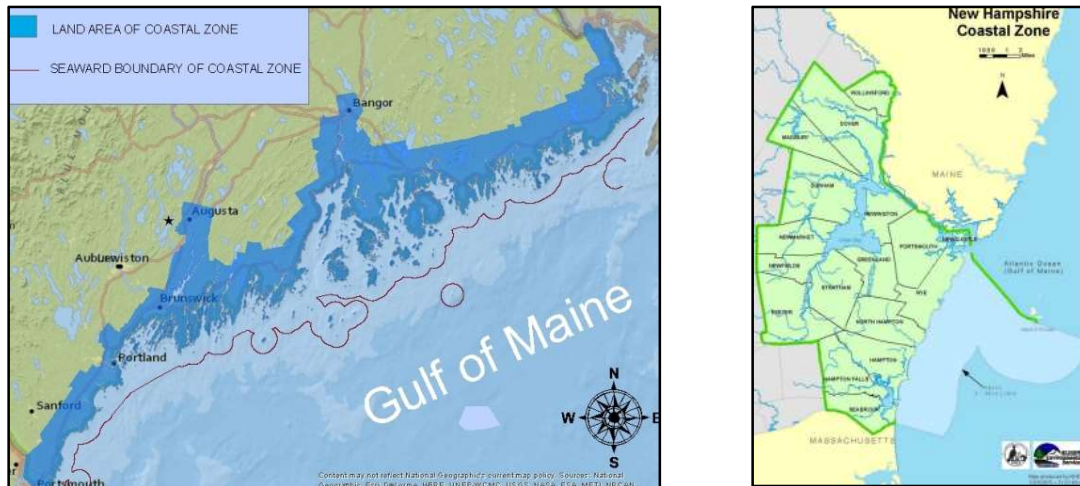


Figure 1. Maine and New Hampshire coastal zones.

There were two versions of the mixed-mode survey: one with a focus on beach use and the other focused on seafood consumption. Our sample of 2666 Maine residents were split, half (n=1333) received a ME Beaches version of the survey, the other half (n=1333) received the ME Shellfish version of the survey<sup>4</sup>. Correspondingly, of the 1334 New Hampshire residents in the pilot sample, half (n=667) received a NH Beaches version of the survey, the other half (n=667) received the NH Shellfish version of the survey<sup>5</sup>. A total of 4000 invitations were mailed to Maine and New Hampshire residents living on the coast, and we received 1766 useable survey responses<sup>6</sup> (427 undeliverable) for a 33 percent response rate. We oversampled residents in the Frenchman Bay (N=42) and Wells (N=68) regions of ME, as well as the Great Bay (N=40) region in NH. The NEST Safe Beaches and Shellfish Project designated the aforementioned regions as reference sites for biophysical research. The oversample will allow for analysis of spatial differences between residents in reference regions, or between residents in individual regions and residents living along the rest of the coast.

<sup>2</sup> Maine Coastal Zone Program Map: [http://www.maine.gov/dacf/mcp/about/coastal\\_zone\\_map.htm](http://www.maine.gov/dacf/mcp/about/coastal_zone_map.htm)

<sup>3</sup> New Hampshire Coastal Zone Program Map: [http://des.nh.gov/organization/divisions/water/wmb/coastal/documents/nh\\_coastal\\_zone\\_map.pdf](http://des.nh.gov/organization/divisions/water/wmb/coastal/documents/nh_coastal_zone_map.pdf)

<sup>4</sup> Maine residents were oversampled in the NEST project reference sites of Frenchman Bay and Wells.

<sup>5</sup> New Hampshire residents were oversampled in the NEST project reference site of Great Bay.

<sup>6</sup> The number of respondents from Maine is 823 across the beach and seafood focused versions, and 353 from New Hampshire.

## A) WHAT INFORMATION DID WE CAPTURE?

The mail survey instrument used a tailored design: the survey booklets were distributed through the mail along with \$1.00 incentive for residents (Dillman, Smyth, and Christian, 2014). The design of the survey was informed by a Pilot Survey conducted exclusively online in 2015. After surveys were returned, we entered all data into Qualtrics online software to streamline data analysis through the use of data panels and mergefields. The survey consisted of five main sections:

### *Resident priorities for coastal management and water quality knowledge*

- Ranking of coastal water quality
- Factors impacting water quality
- 'Myths' about water quality
- Benefits of good water quality
- Consequences from poor water quality

### *Beach use or shellfish consumption*

- Beach activities/shellfish consumption habits
- Information seeking behavior
- Knowledge of advisories

### *Willingness to contribute to coastal water quality improvement*

- Priorities in protecting coastal water quality
- Willingness to contribute to improvement program
- Preferences for how program funds are distributed
- Preferences for program outcomes

### *Personal characteristics, risk behaviors and perception, belief in climate change, trust in scientists*

- Risky behaviors and perception
- Climate change beliefs
- Trust in science
- Perceived personal and governmental responsibility for coastal water quality (and effectiveness of government)

### *Demographics*

- Standard demographics including years lived in home state
- Participation in coastal activities within the last year

## B) WHO PARTICIPATED IN THE STUDY?

We begin with demographics in order to provide a more detailed description of our survey participants. The average age of our respondents was approximately 59, and more males than females answered the survey (Table 1). Most respondents (98%) answered that the address to which the survey was mailed is that of their primary residence. Respondents had lived at the residence for an average of nearly 17 years, and in their home state for an average of nearly 38 years. Thus, many of our results are from the perspective of long time, year-round residents in both Maine and New Hampshire.

	Average Age			Percent Male Respondents		
	Coastwide Mail Survey Respondents	Sampled Towns <sup>a</sup>	Statewide	Coastwide Mail Survey Respondents	Sampled Towns <sup>a</sup>	Statewide
Maine	60	48	43	58	53	50
New Hampshire	57	44	42	58	52	50

Statewide and town data are from the 2010 U.S. Census. <sup>a</sup>Sampled town data are weighted by population. Total respondents in Maine = 795; total respondents in New Hampshire = 345.

A majority of survey respondents (81%) reported that they had some college education or higher, including those with 1-3 years of college (or an Associate's degree), college graduates, and postgraduates. Employment status differed between the two states (Table 2). There were significantly more full-time employed residents among the New Hampshire respondents than Maine ( $t=-3.45$ ,  $p<0.001$ ). Maine respondents included a significantly higher number of residents employed at home (self-employed) than New Hampshire ( $t=2.27$ ,  $p<0.05$ ). There was no statistical difference between Maine and New Hampshire in terms of the number of part-time, homemaker, retired, or unemployed residents in each. The average income for New Hampshire respondents was much higher at \$100,053 per year, compared to \$84,759 per year in Maine.

	Maine	New Hampshire
Student	0.9	0.6
Unemployed	1.0	1.5
Homemaker	2.1	1.2
Employed at Home	4.5	1.7
Part-time	9.06	7.5
Retired (not working)	38.2	32.8
Full-time	44.2	54.8
Total Respondents	795	345



## C) HOW DID WE ANALYZE OUR DATA?

We analyzed the survey response data with SAS 9.4 (SAS Institute Inc, 2013). Our inferential statistics include chi-square tests of distribution differences, t-tests and analysis of variance (ANOVA). The age and gender comparison statistics using 2010 U.S. Census data<sup>7</sup> were calculated in Microsoft Excel. The coastal resident survey was launched in August 2015, with survey responses being received into December.

## STUDY FINDINGS

### 1) COASTAL WATER QUALITY AND CITIZEN/GOVERNMENT RESPONSIBILITY



Figure 2. Maine's Coastal Beaches, source: <http://www.maineoastdata.org/public/>

#### Why is water quality important?

As residents of Maine and New Hampshire's coastal zone (Figure 2), our respondents have a unique perspective about water quality. For our respondents, the most important aspects of the coast are: 1) Clean ocean, estuary, and river waters (97%), 2) Beautiful scenery (89%), and 3) Public access to coastal resources (86%).

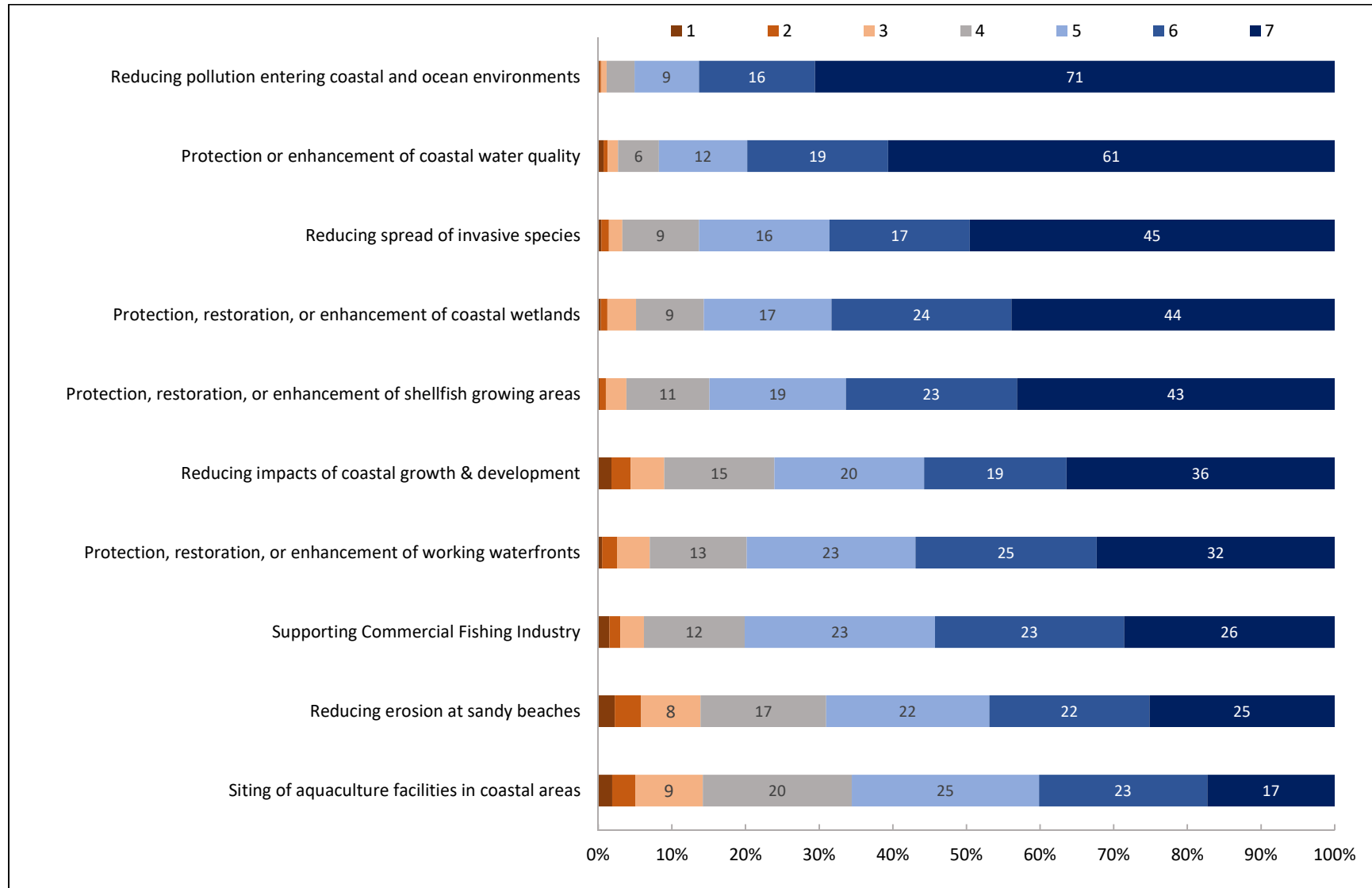
Respondents were asked to assign rankings for different priorities for coastal managers; they were offered a Likert scale of 1 ("should not be done") to 7 ("top priority"), where they were allowed to select more than one option as a top priority.

Reducing pollution entering coastal and ocean environments were assigned top priority by the majority of respondents (71%), while 61 percent of respondents assigned top priority to "protection or enhancement of coastal water quality" (Figure 3).

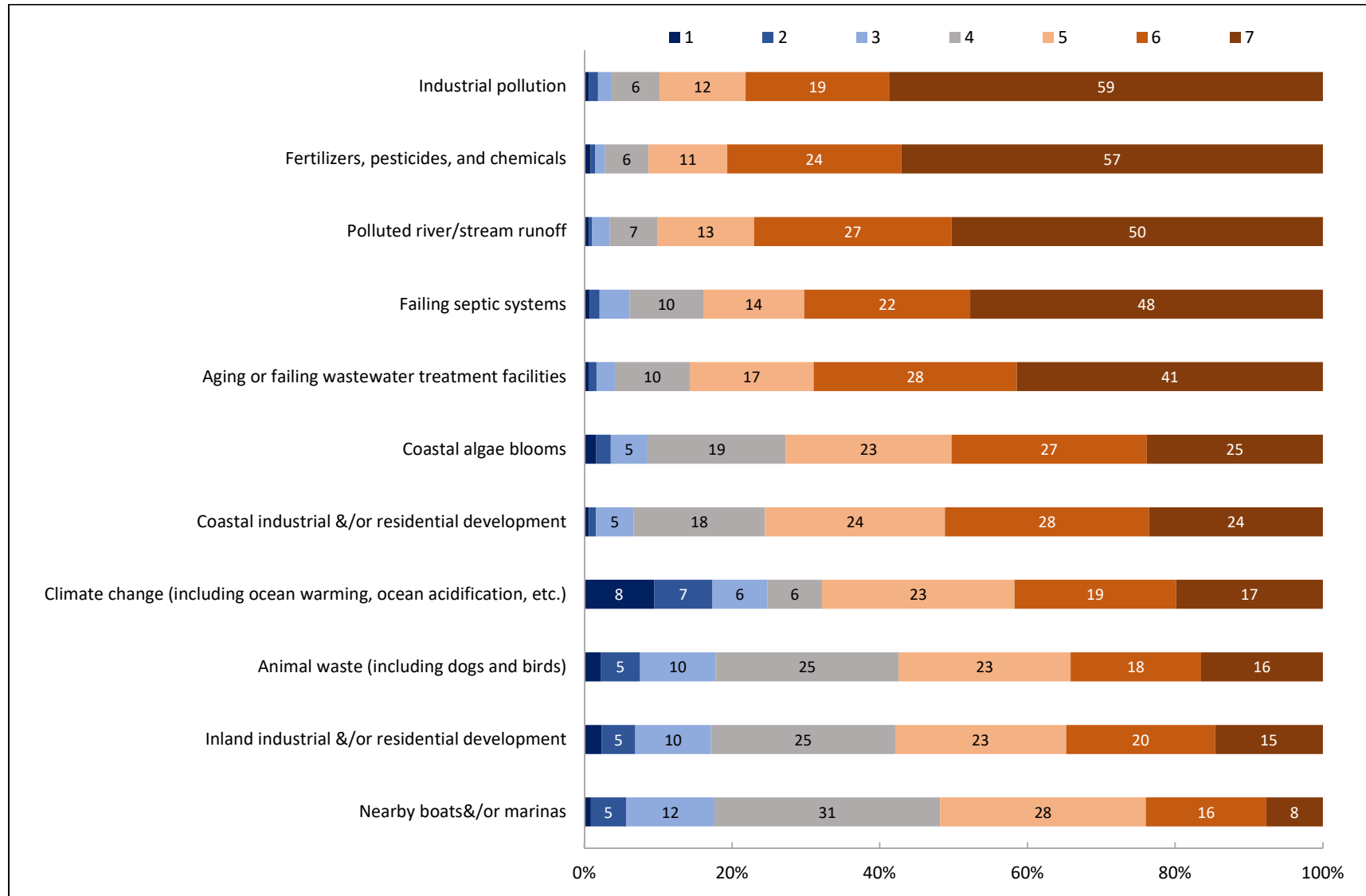
Respondents perceived that the major detractors from coastal water quality were pollution and chemicals. Industrial pollution ranked highest in terms of perceived negative impact, while fertilizers, pesticides, and other chemicals were a close second (Figure 4). The highest ranked, or "very important" (7/7 on the Likert scale), outcome associated with a coastal water quality program was a healthy marine environment (Figure 5).

<sup>7</sup> An overview of the Maine 2010 Census is available in PDF format: <http://www.census.gov/prod/cen2010/cph-2-21.pdf>. Likewise, the New Hampshire 2010 Census overview is available in PDF format: <https://www.census.gov/prod/cen2010/cph-2-31.pdf>.

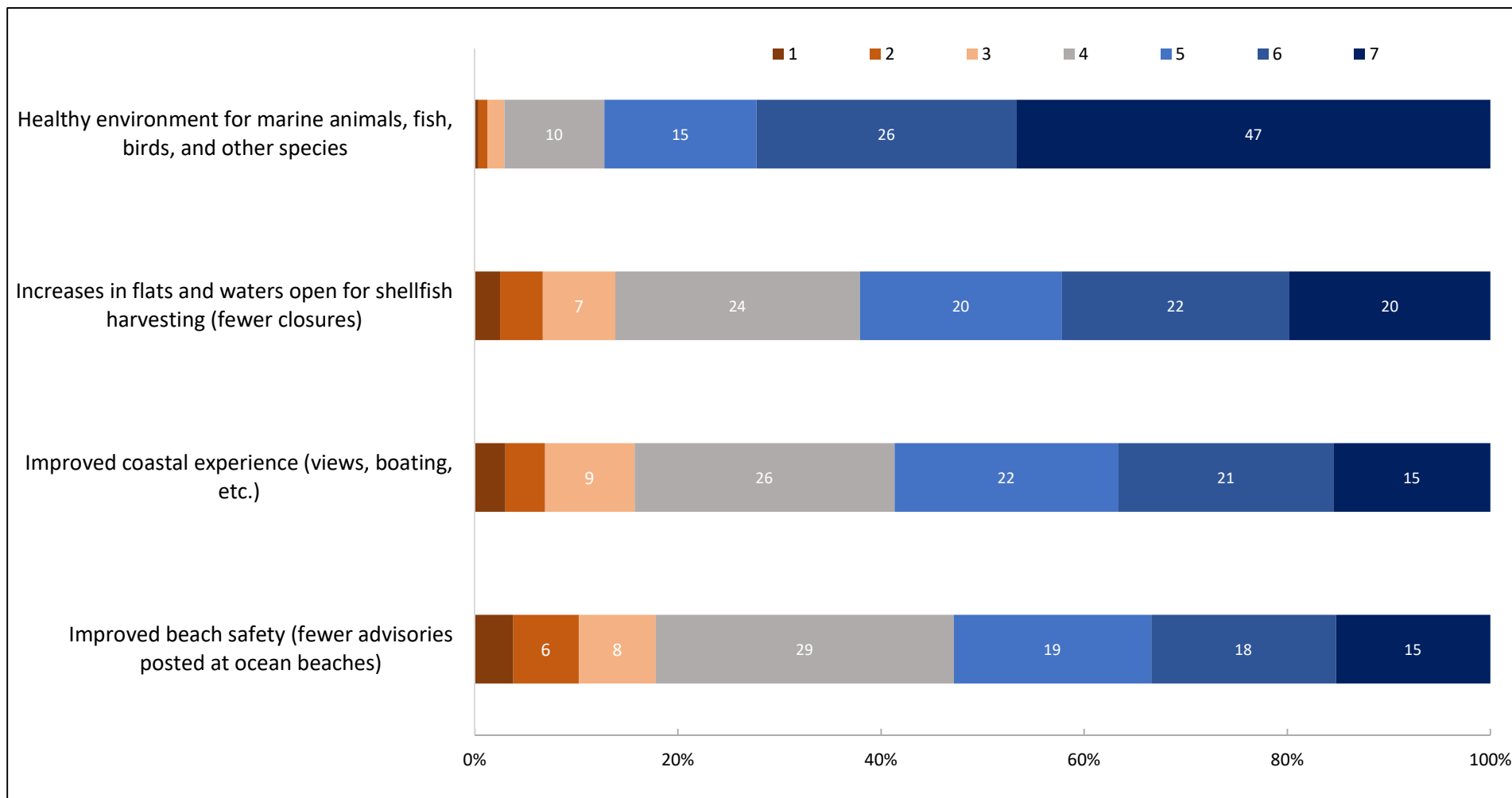
**Figure 3.** Citizen priorities for coastal managers, ranked by urgency (1=Should not be done, 7=Top priority); respondents were allowed to select more than one action as "top priority". Percentage values <5 not displayed.



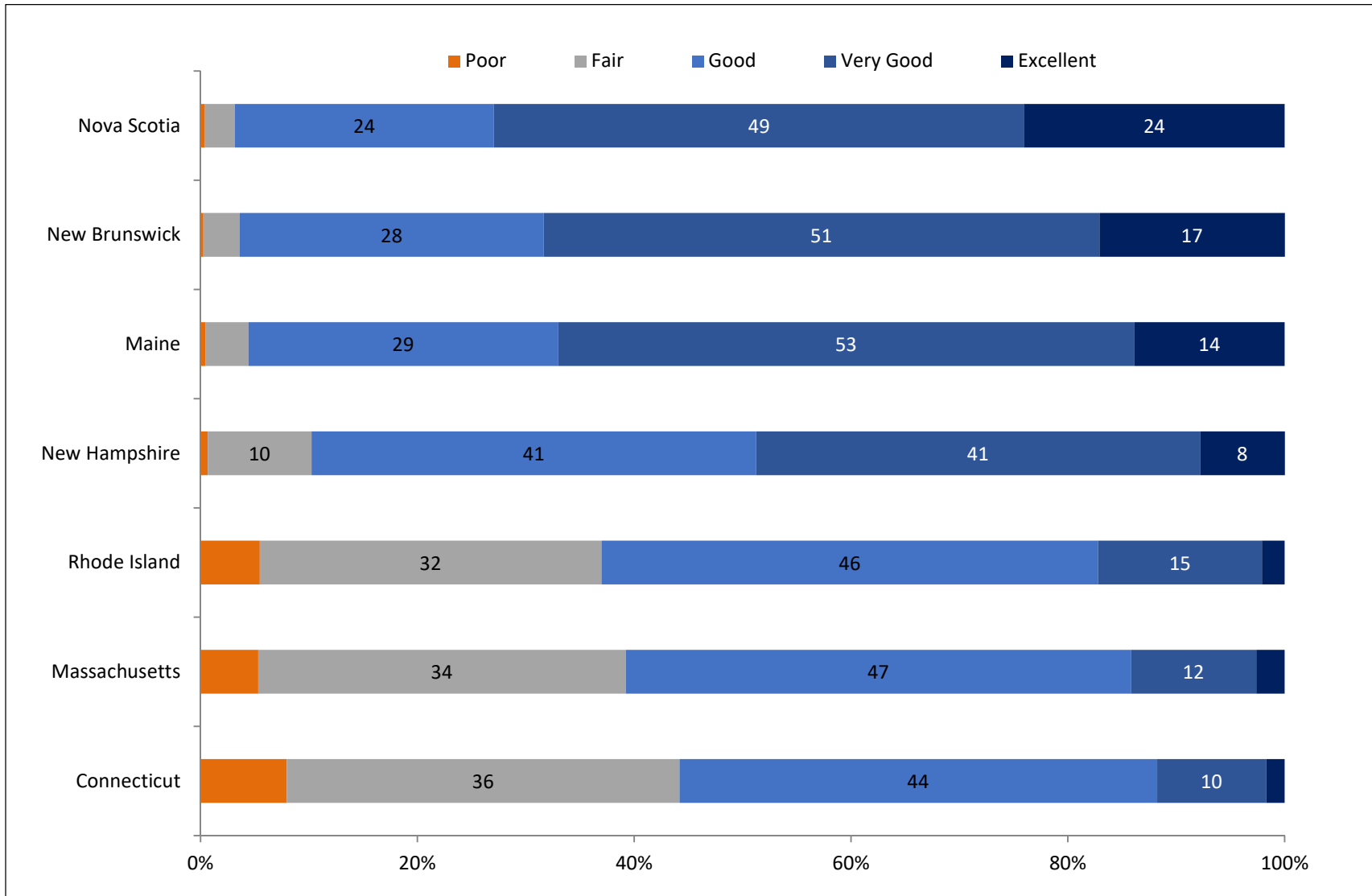
**Figure 4.** Resident perceptions about factors negatively impacting water quality (1=No negative impact, 4=Somewhat negative, 7=Very negative); respondents were allowed to choose "very negative" for more than one factor. Percentage values <5 not displayed.



**Figure 5.** Respondent ratings of hypothetical Coastal Water Quality Program outcomes (1=not at all important, 4=somewhat important, 7=very important); respondents were allowed to pick more than one outcome as "very important". Percentage values <5 not displayed.



**Figure 6.** Percentage respondents New England states and Canadian provinces for their coastal water quality; data labels provided for select ratings. Percentage values <5 not displayed.



### How do residents rate their home state's water quality?

The 2014 Natural Resource Defense Council's (NRDC) report entitled, "Testing the Waters" ranks New Hampshire 2<sup>nd</sup> in the nation in terms of coastal water quality, while Maine is rated 27<sup>th</sup> (out of 30)—a noteworthy difference for neighboring states.<sup>8</sup> When asked to evaluate coastal water quality in five states (Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut) and two provinces (New Brunswick and Nova Scotia) respondents ranked Nova Scotia as having the best water quality (mean=3.93 out of 5) with New Brunswick ranked as second (mean=3.82, Figure 6). Maine and New Hampshire citizens evaluated water quality differently; New Hampshire respondents consistently ranked all regions higher than Maine respondents ( $t \leq -2.80$ ,  $p < 0.01$  for all states, including Maine). Maine citizens gave water quality lower ratings in their home state and New Hampshire than New Hampshire citizens did.

### Who is responsible for coastal water quality? Does how we talk about it matter?

Resident perceptions about who should be responsible for the management and protection of coastal water quality as a public resource may vary, which may impact individual level and policy support decisions. We investigate individuals' sense of responsibility for coastal waters, whether they believe other individuals should be responsible, and finally whether they believe state or local entities should be responsible for water quality. Approximately 77 percent of respondents agree that coastal water quality protection is the responsibility of local government (Figure 7). Eighty-one percent of respondents agree that coastal water quality protection is the responsibility of state government. Interestingly, state of residence matters when thinking about local responsibility—New Hampshire residents are more likely than Maine residents to agree with the statement, "Local government is responsible for protecting coastal water quality" ( $t = -2.14$ ,  $p < 0.05$ ).

Although they place the responsibility of water quality protection on government, respondents appeared to have little faith in government bodies actually taking steps to protect water quality. Only around 37 percent of respondents agree that local government is *effective* in protecting water quality. Similarly, only 38 percent of respondents agree that state government is effective in protecting water quality. There was no significant difference between Maine and New Hampshire residents when asked about the effectiveness of government in water quality protection.

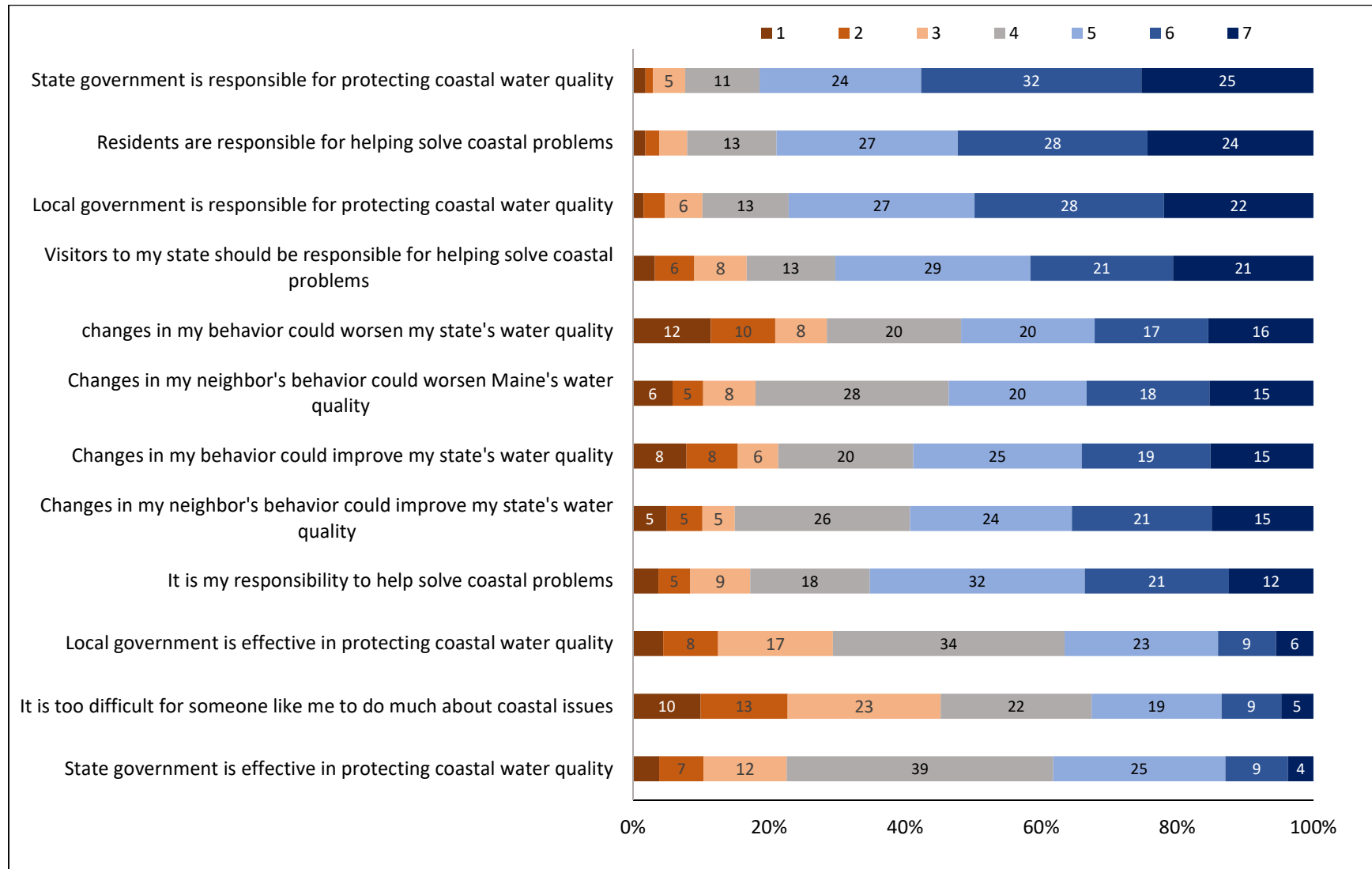
Respondents' perceived responsibility for water quality protection did not lie entirely with government. The majority of respondents from both Maine and New Hampshire (79%) believe that residents are responsible for protecting coastal water quality (Figure 7). When asked about impacts which they might personally have on water quality, 51 percent agreed that changes in their own behavior could *worsen* water quality, while 54 percent agreed that changes to their behavior could *improve* coastal water quality. When asked about the possibility of others changing their behavior to improve coastal water quality, 59 percent of respondents agreed that their *neighbors* could make positive changes to improve water quality, while 54 percent agreed that *changes to their neighbors'* behavior could worsen water quality.

---

<sup>8</sup> Maine's low rating may be due to the 19% of water samples which exceeded the national Beach Action Value (geometric average of *Enterococci* colonies per 100mL water). New Hampshire, on the other hand, had only 3% of water samples exceed the national Beach Action Value.

We recognize that citizens from different states or regions may have differing concepts of what 'coastal water quality' is; we tested differing frames for thinking about coastal water quality to determine how the context of the problem impacts citizen evaluation of water quality, and other behaviors. We asked questions about the different 'myths' related to water quality as a means to address concerns expressed by our coastal program collaborators from Maine Healthy Beaches. Most respondents (72%) believe that a large number of birds or other animals (including dogs) make water quality worse. A majority of respondents (65%) agreed that recent heavy rain makes water quality worse as well. Maine and New Hampshire resident responses were significantly different for "large number of swimmers" ( $t=2.29$ ,  $p<0.05$ ); New Hampshire residents felt more strongly that a large number of swimmers makes water quality much worse. Maine and New Hampshire resident responses were also different for "recent heavy rain" ( $t=-2.73$ ,  $p<0.01$ ); Maine residents felt more strongly that recent heavy rainfall made water quality much worse.

**Figure 7.** Percentage of respondents agreeing to statements about responsibility for water quality; respondents rated categories on a Likert scale from 1 (strongly disagree) to 7 (strongly agree). Percentage values <5 not displayed.





## STUDY FINDINGS

### 2) INFORMATION and COASTAL ACTIVITIES

#### **Do changes in water quality affect beach visitation?**

Approximately 32 percent of respondents reported visiting a beach on the Gulf of Maine coast at least once a week during the summer. People come to the beach for different reasons; the most popular beach activities were (in order of highest reporting frequency): walking, reading/relaxing, sightseeing, swimming, and eating at local restaurants. While information on water quality may be available, 81 percent of respondents said they *do not ever seek information* about the water quality at their state's coastal beaches. For those respondents who *do seek information* about water quality at Maine and New Hampshire beaches, news and media (23%), as well as family and friends (about 14%), represent their sources of information.

It appears that there is a possible disconnect between awareness of information availability and the places in which citizens would like to find information. Nearly 59 percent of respondents said they would like to see water quality information signs at beach access points, and 35 percent said they would like to find coastal information on a website. It is important to note that swim beach water quality information is *currently provided through both of these options*. Over half of respondents (nearly 57%) report having heard of, or seen, a coastal beach water contact advisory in their state, so the swim beach water quality information is demonstrably accessible. The issue may be that there is a lack of awareness about where to find information about swim beach safety.

We suggest that the problem may lie with citizen perceptions of water contact as a non-risky behavior. Less than 2 percent of our respondents reported themselves or a family member feeling sick after swimming at a Gulf of Maine beach during 2014, when there were a number of water contact advisories posted at Maine swim beaches. Interestingly, survey respondents reported that if they entered the water *during a water contact advisory*, they were (on average) about 50 percent likely to get sick—just like tossing a coin. This risk perception result is notably inconsistent with literature that connects immersion activities or full-body contact with contaminated waters, especially those resulting in ingestion, such as swimming or surfing, with contraction of a gastrointestinal illness (Colford *et al.*, 2007; Dorevitch *et al.*, 2012; Wade *et al.*, 2010). Again, because we know that 81 percent of respondents do not ever seek information about water quality at their state's beaches, it may be that citizens simply are not making the connection that full-body immersion during a water contact advisory is a risky behavior. The small percentage (2%) of respondents reporting a water contact illness may be more reflective of the lack of connection between skin irritations, infections, and gastrointestinal illness in themselves or family members.

#### **Do water quality perceptions affect shellfish consumption?**

A majority of Maine and New Hampshire respondents reported consuming seafood at least once a week (64%). Most respondents said they typically obtain their seafood from a grocery store (74%) or restaurant (72%). Only around 12 percent of respondents responded that they or a family member feeling sick (non-allergic) after eating shellfish. The majority of these (non-allergic) illnesses went unreported: 80 percent of respondents who fell ill after eating shellfish said they did not report their (non-allergic) illness to the restaurant, or a doctor. Though seafood-related illness (non-allergic) was far more commonly reported than water-borne illness (12% and <2% reported illness,

---

respectively), 69 percent of respondents said they did not ever seek information about the safety of eating seafood, which is perhaps not surprising given that there are government regulations in place to ensure that shellfish obtained from a contaminated area do not make it to the grocery store or seafood restaurant. In addition, 85 percent of respondents had heard of, or seen, a shellfish area closure. Of those participants who do seek information about the safety of eating seafood, most report seeking information from news and media sources (29%) or their seafood wholesaler/retailer (16%), followed by family and friends (13%), and finally by local harvesters (9%).

Interestingly, only around half (53%) of respondents believed they were likely to get sick (non-allergic) if they consumed shellfish from an area posted as “closed due to bacterial pollution.”

## STUDY FINDINGS

### 3) ECONOMIC VALUATION

#### **What factors influence a person’s willingness to contribute?**

Economic valuation questions were included in the survey in order to assess citizens’ support for water quality programs. The economic valuation questions utilized the contingent valuation (CV) method, where respondents were asked about their willingness to pay to help support a hypothetical coastal water quality program through an increase in monthly sewer/water/septic fees. Majority vote leads us to believe that citizens living on the Gulf of Maine coast would support a coastal water quality program: nearly 58 percent of Maine residents and 54 percent of New Hampshire residents surveyed were willing to contribute to a hypothetical Coastal Water Quality Program. There was no statistical difference between states in terms of willingness to contribute.

The fee associated with the hypothetical water quality program is a statistically significant factor explaining willingness to contribute; participants who saw a lower dollar value for the increase in their sewer/water/septic bill were significantly more likely to contribute. For example, nearly 84 percent of those who saw the question posed with a fee increase of \$2 per month in a sewer/water/septic bill were willing to contribute to a coastal water quality program (Figure 8). Those who saw a higher dollar value were significantly less likely to contribute ( $t=11.71$ ,  $p<0.0001$ ).

Individual responsibility plays a major role in coastal water quality program support. Residents who agreed with the statement, ‘[Maine or New Hampshire] residents are responsible for helping to solve coastal problems’ were significantly more likely to say “yes” to supporting a coastal water quality program ( $t=-8.71$ ,  $p<0.0001$ ). Similarly, residents who agreed with the statement, ‘I am responsible for helping to solve coastal problems’ were significantly more likely to be willing to support a coastal program ( $t=-8.80$ ,  $p<0.0001$ ).

Sense of control and the impact of individuals on water quality also appear to play a substantial role in a resident’s willingness to pay to support a hypothetical coastal water quality program. Respondents who agreed with the statement ‘It is too difficult for someone like me to do much about coastal problems’ were significantly more likely to say “no” to supporting a hypothetical coastal water quality program ( $t=6.39$ ,  $p<0.0001$ ). Respondents indicating that their everyday behavior has an impact on water quality were significantly more likely to be willing to contribute; this includes those who felt that changes to their personal behavior could improve water quality ( $t=-8.94$ ,  $p<0.0001$ ),

and those who felt that changes to their personal behavior could worsen water quality ( $t=-8.13$ ,  $p<0.0001$ ). Likewise, respondents indicating that their neighbors' behaviors have an impact water quality were significantly more likely to be willing to support the Coastal Water Quality Program; this includes those who felt that changes to their neighbors' behavior could improve water quality ( $t=-8.51$ ,  $p<0.0001$ ), as well as those who felt that changes to their neighbors' behavior could worsen water quality ( $t=-4.51$ ,  $p<0.0001$ ). The connection residents make between the actions of individuals and coastal water quality appears to be an important determinant of program support.

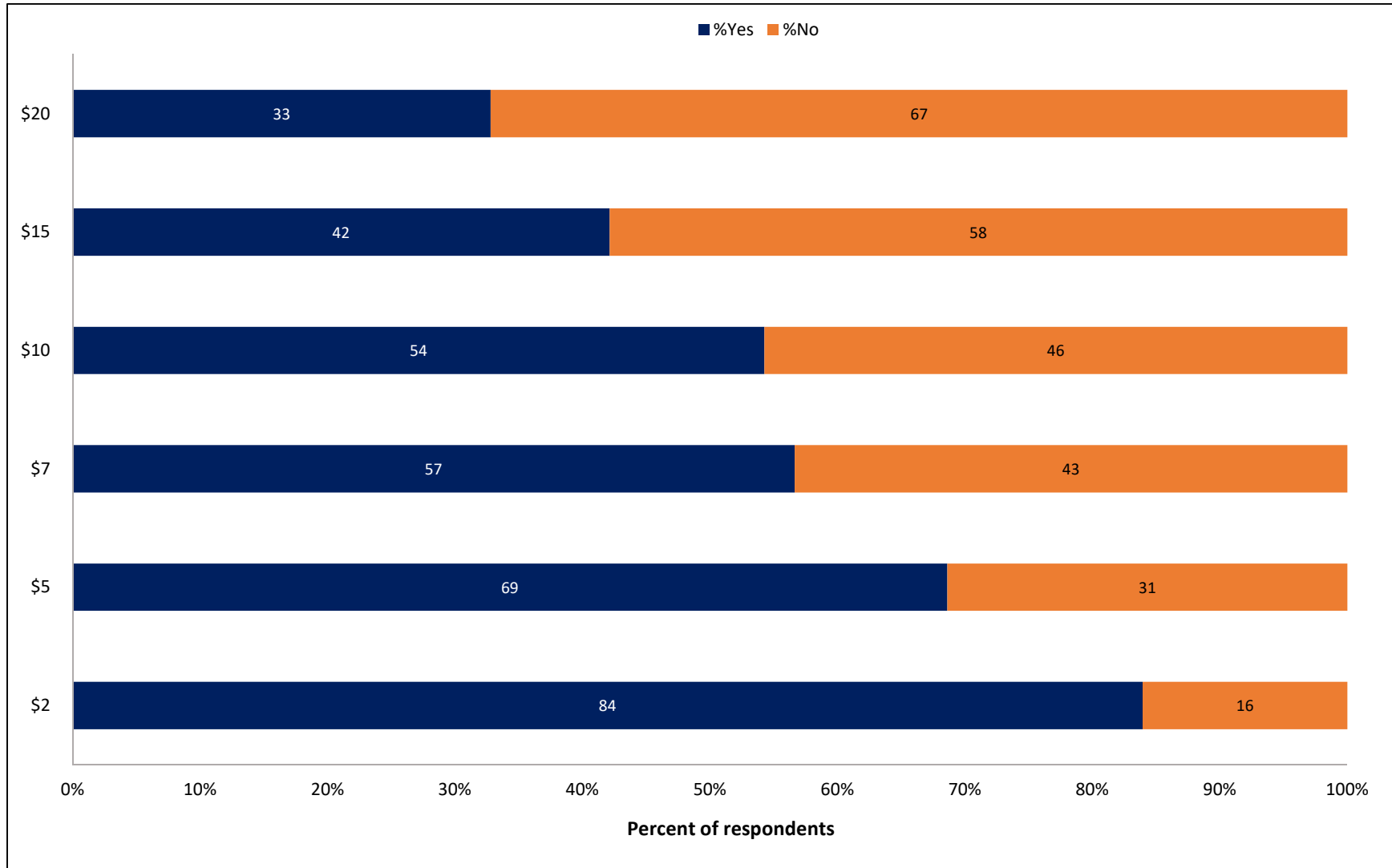
#### **Where do residents prefer to allocate budget shares?**

Respondents were asked to allocate a hypothetical Coastal Water Quality Program budget toward actions to improve, protect, or monitor water quality. Residents show awareness of how a Coastal Water Quality Program should, "walk the walk": Maine and New Hampshire residents allocate the largest budget shares to actions which mirror top citizen priorities for coastal managers. Recall that residents' top priorities for coastal managers were "reducing pollution entering coastal and ocean environments" (71%) and "protection or enhancement of coastal water quality" (61%). On average, respondents dedicated the largest percentages (22%) of the hypothetical Coastal Water Quality Improvement Program budget to "improving wastewater treatment, sewer and stormwater runoff infrastructure" and "improving water quality monitoring to detect pollution sources" (15%).

#### **What are residents' preferred program outcomes?**

The coastal water quality program outcome that received the highest rating by respondents was "healthy environment for marine animals, fish, birds, and other species" (87%), followed by "increases in flats and waters open for shellfish harvesting (fewer closures)" (62%). These outcomes reflect citizen concerns about environmental and public health.

**Figure 8.** Willingness to contribute to a coastal water quality program by fee amount; percentages represent the percentage of citizens responding yes or no to support at each dollar amount. Percentage values <5 not displayed.



## DISCUSSION

### **How can we better communicate with the public about environmental and public health risk?**

Given that very few respondents (12%) reported shellfish-related illness, and even fewer respondents (<2%) reported water contact-related illness we could infer that current coastal water quality monitoring programs in Maine and New Hampshire are doing a good job of keeping Gulf of Maine coastal waters safe for beachgoers and shellfish. Another possibility is that residents may not be tracing illness back to its cause—either through contact with contaminated water or consumption of unsafe shellfish. Thus, effective communication with residents about the public health risks associated with poor coastal water quality is still very important.

If 81 percent of respondents do not seek information about water quality before going to the beach, how are they making decisions about whether or not to enter the water? Their decisions may be based in experience. If less than 2 percent of respondents report water-contact related illness, they may assume their favorite beaches are always free from contamination or would have water contact advisories posted if bacteria levels were high. Beachgoers may also buy into popular water quality myths, such as: “water quality is better by the mouth of a river” (false), and “water quality is better with a large number of swimmers in the water” (also false). Nearly half of respondents (45%) believe that a large number of swimmers has no impact whatsoever on water quality. Likewise, many respondents (42%) believe that rivers and streams meeting the ocean have no impact on water quality. Studies show that a large number of swimmers in the water has a potential to worsen water quality (Dorevitch *et al.*, 2012; Wade *et al.*, 2010). Similarly, water quality at the mouth of the river has the potential to be negatively impacted by the freshwater and the particulates flowing down from upstream (Vega *et al.*, 1998). The number of respondents who believe that these scenarios have no impact on water quality demonstrates that these water quality myths remain persistent. The perceived lack of impact and the persistence of these water quality myths may help us think about how to better communicate the risks associated with contaminated water.

### **How can we promote safety information about beach and shellfish growing area advisories or closures?**

Many respondents reported that they check news/media for shellfish (29%) and beach safety information (23%), but the local newspapers do not publish a growing area status or beach advisory status report with the weather report or tide charts. Fifty-nine percent of respondents said they would like to see beach advisory information posted at beach access points, but many beaches already have beach information signs posted in those locations. This may indicate that respondents are frequenting beaches not participating in the Healthy Beaches Program, or they may not be seeing the beach status signs already in place. We explored this question further in a follow-up study with beach monitors in the Maine Healthy Beaches Program, and we continue to partner with the Maine Healthy Beaches Program to explore different messaging and informational techniques in order to increase effectiveness of communication efforts.

---



Thirty-five percent of respondents said they would like to find beach safety information online, but many beach water quality programs already provide up-to-date safety and closure information on each of their websites. The EPA-funded Maine Healthy Beaches Program provides beach status updates online.<sup>9,10</sup> In New Hampshire, the Department of Environmental Services oversees the Beach Inspection Program which provides advisory status information online. Both agencies would reach a wider audience if they were to make swim beach status postings available through print media sources such as tide charts for local harbors or weather reports, as well as the programs' respective websites. Acknowledging that live reporting requires some serious coordination, a newspaper-published swim beach status after weekly sampling might still be beneficial, especially if it directed viewers online to the updated webpage.

Shellfish sanitation information is also available online. Maine Department of Marine Resources provides shellfish pollution area inventory information for emergency flood closures (during and after rain events) and conditional area closures on their website, along with their Shellfish Sanitation Program hotline contact information.<sup>11</sup> Similarly, the New Hampshire Department of Environmental Services provides shellfish closure information on their website via the New Hampshire Coastal Atlas.<sup>12</sup>

### **How might we encourage feelings of responsibility for environmental and public health?**

Respondents' perceived responsibility toward coastal water quality is revealing. Recall that respondents who felt that there were personal behavioral changes they could make to improve the quality of coastal water were willing to contribute to the hypothetical Coastal Water Quality Improvement Program, while those that felt that it was too difficult for them to do much about coastal problems were significantly less likely to be willing to contribute through an increase in fees on their sewer/water/septic bill. How can we support water quality education focusing on changes

<sup>9</sup> Maine Healthy Beaches beach status page: <http://www.maine coastdata.org/public/CurrentBeachStatus.aspx>

<sup>10</sup> Maine Healthy Beaches fact sheet: <http://www.mainehealthybeaches.org/science.html#tested>

<sup>11</sup> Maine DMR shellfish pollution area inventory list:  
[http://www.maine.gov/dmr/rm/public\\_health/closures/closedarea.htm](http://www.maine.gov/dmr/rm/public_health/closures/closedarea.htm)

<sup>12</sup> New Hampshire DES New Hampshire coastal atlas: <http://xml2.des.state.nh.us/CoastalAtlas/Atlas.html>

people can make in their own lives? How can we help folks realize that everyone can do something to help improve water quality?

### **Where can we go from here?**

All evidence points toward citizens' general understanding about the cause of water quality issues (save a few persistent water quality myths). Despite this understanding, water quality issues are still common in the Gulf of Maine coastal region. Water quality problems can be especially challenging for coastal managers because they vary from community to community—there is no silver bullet. Citizen understanding of water quality problems may be enhanced through education efforts making the explicit connection between beach monitoring, beach advisories, and risk for water-contact illness. Signage near public waterfront access or tide charts about the shellfish safety hotline may help prevent foodborne illness in recreational harvesters unfamiliar with safe harvesting practices.

### **Future directions for research**

While there are many avenues for future research, we concentrate here on the scale of analysis. We did not analyze these data for spatial differences on a scale finer than state-wide. It would be informative to test for differences between response patterns on a town level.

## REFERENCES

- Colford, J.M. Jr., Wade, T.J., Schiff, K.C., Wright, C.C., Griffith, J.F., Sandhu, S.K., Burns, S., Sobsey, M./, Lovelace, G., Weisberg, S.B. (2007) Water quality indicators and the risk of illness at beaches with nonpoint sources of fecal contamination. *Epidemiology*. 18(1), 27-35
- Dillman, D.A., Smyth, J.D., and Christian, L.M. (2014) *Internet, Phone, Mail, and Mixed-Mode Surveys: The Tailored Design Method*. John Wiley & Sons, Inc. Hoboken, New Jersey.
- Dorevitch, S., Pratap, P., Wroblewski, M., Hryhorczuk, D.O., Li, H., Liu, L.C., Scheff, P.A. (2012) Health risks of limited-contact water recreation. *Environmental Health Perspectives*. 120(2), 192-197
- Maine Department of Marine Resources.  
([http://www.maine.gov/dmr/rm/public\\_health/closures/closedarea.htm](http://www.maine.gov/dmr/rm/public_health/closures/closedarea.htm)).
- Maine Healthy Beaches Program. (<http://www.mainehealthybeaches.org/science.html#tested>).
- New Hampshire Business Review. (<http://www.nhbr.com/May-1-2015/Tourism-promotion-is-essential-to-our-economy/>).
- Natural Resource Defense Council (2014). *Testing the Waters 2014: A Guide to Water Quality at Vacation Beaches*. (<http://www.nrdc.org/water/oceans/ttw/me.asp?loc=Maine>). Date of access: 10/07/2015.
- SAS** Institute Inc. 2013. **SAS® 9.4** Guide to Software. Updates. Cary, NC: **SAS** Institute Inc.
- Vega, M., Pardo, R., Barrado, E., Debán, L. (1998) Assessment of seasonal and polluting effects on the quality of river water by exploratory data analysis. *Water Research*. 32(12), 3581-3592.
- VisitMaine.com. ([http://visitmaine.com/assets/downloads/2013\\_MaineFactSheet.pdf](http://visitmaine.com/assets/downloads/2013_MaineFactSheet.pdf)).
- Wade, T.J., Sams, E., Brenner, K.P., Haugland, R., Chern, E., Beach, M., Wymer, L., Rankin, C.C., Love, D., Li, Q., Noble, R., Dufour, A.P. (2010) Rapidly measured indicators of recreational water quality and swimming-associated illness at marine beaches: a prospective cohort study. *Environmental Health*. 66(9), 1-14