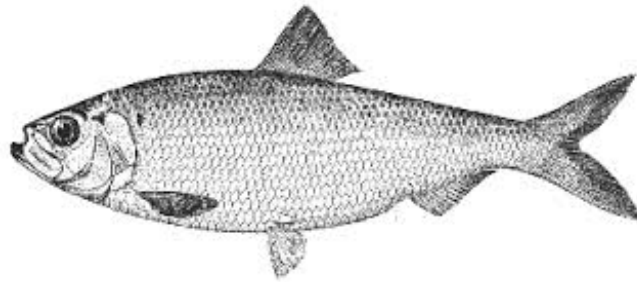# Coordinating Volunteer River Herring Monitoring Programs in Maine and Massachusetts: Operations, Strategies and Recommendations

Prepared by: Karen H. Bieluch, Dartmouth College, Jason Smith, University of Southern Maine, and Theodore Willis, University of Southern Maine

9/30/2015

Executive Summary

This technical report contributes to a study on volunteer river herring monitoring programs and the use of monitoring data in river herring management in Maine (ME), Massachusetts (MA), and New Hampshire (NH). In this report, we summarize research findings from interviews with people who coordinate a sample of volunteer monitoring programs of river herring in ME and MA. We document their program successes and challenges, and we offer a set of recommendations for consideration for present and future volunteer monitoring programs. This is a collaborative study being conducted by researchers at Dartmouth College (Dartmouth), University of Southern Maine (USM), and University of Maine (UMaine).

We conducted 19 face-to-face and phone interviews with volunteer monitoring program coordinators between June and August 2014. The interview data is summarized in this report.

Key Results and Recommendations

Program Goals: Above and beyond simply collecting data, coordinators emphasized that their programs helped build river and resource stewardship, assisted with ensuring run success by keeping an eye on the run and alerting people to problems, and educating volunteers, community members and the general public about river herring and the local ecosystem.

> Recommendations: When evaluating the success and importance of these volunteer monitoring programs, it is critical to monitor interactions between local and regional scales. Programs goals should be communicated to the volunteer base. Since each volunteer participates for multiple reasons (Smith et al., 2015), it is important to publicize all goals to enhance volunteer identification with the program and learn how they can further support or partake in the management process of river herring.

Volunteer Recruitment: The most frequently cited outreach strategy was reaching out to local organizations, such as watershed groups, to assist with recruitment. These groups typically have member lists and often draw on volunteer support to accomplish their work. Coordinators typically recruit new volunteers through ads or stories in local newspapers, electronic communication (e.g. email, Facebook, Twitter, organization website), and word-of-mouth.

> Recommendations: If a run is not already connected with a local watershed or ecology-related organization, we recommend that coordinators explore collaboration opportunities to assist with volunteer recruitment.

> Coordinators should assess the interests and needs of their target audiences to tailor recruitment messages. For example, when recruiting youth, make sure to suggest that the time may be counted toward community service graduation requirements.

Training Volunteers: The majority of coordinators held a preseason, in-person group training, on- or off-site. Several coordinators held individual trainings only or in-addition to group trainings.

Trainings typically consist of discussions about program logistics, such as how to count and how to use the monitoring equipment, and fish and site information, such as river herring biology and site history. Some trainings include guest speakers.

> Recommendations: We recommend providing paper instructions for counting on-site and following-up with volunteers via email or social media (e.g. Facebook) throughout the monitoring season. Follow-up communication may include, for example, sending a picture comparing a bass versus an alewife or providing suggestions for counting in-migrating versus ex-migrating fish. These strategies reinforce the training and may strengthen the overall quality of the data through continued education.

> Coordinators may want to consider pairing experienced volunteers with new volunteers to assist the coordinator with training and to strengthen connections between volunteers.

Volunteer Retention: Strategies for retaining volunteers included: 1) sending an email blast announcing the upcoming season to volunteers from previous years, followed by individualized communication. 2) Staying in touch with volunteers throughout the season by keeping volunteers updated and being responsive to volunteer questions and recommendations, and 3) Acknowledging volunteers and saying thank you via email or through end-of-season events.

Volunteer Coordinator-Volunteer Communication: The majority of coordinators communicate with volunteers via email and face-to-face group events and meetings. Approximately half of the coordinators noted they had infrequent communication with volunteers during the counting season, and the other half reported weekly, bi-weekly, or "regular" communication with volunteers during the monitoring season.

> Several coordinators cited "regular" communication as a key communication strategy in their programs. Essentially, the coordinators argued that it is important to communicate with volunteers throughout the monitoring season, although what that communication looks like will likely vary by program. When considering communication techniques, one must take into account the needs and wants of the volunteers and coordinator capacity for communication.

> Recommendations: To facilitate communication among volunteers, coordinators recommended developing a group Listserve, implementing a team-based counting system (i.e. teams for each count slot), or by making the schedule calendar publically accessible and modifiable to coordinate scheduling.

Role of Volunteers: Coordinators discussed that volunteers not only count river herring, but many also help with entering the count data, coordinating volunteer schedules and recruitment efforts, applying for grant funding for restoration, and maintaining the run (e.g. removing debris).

> Recommendations: There is some basic information that volunteers need, such as run status updates and information, count scheduling, event details, and count results and run population estimates. Volunteer recognition and education are also important for both volunteer retention and for data quality, respectively.

Data Collection, Organization, Use, and Needs:

Programs typically use Nelson's (2006) statistical sampling guide for the estimation of river herring run size using visual counts. The counting periods (i.e. 10 or 30-minute blocks) tend to vary by state, with several Maine runs using 30-minute counts. Almost all coordinators provide to their volunteers the final count results and population estimates.

Coordinators expressed some concerns with data quality and usability. For example, participants identified conditions, such as poor weather and high numbers of fish passing during a counting session that may compromise data accuracy. Several coordinators also expressed concerns with the robustness of the data for drawing conclusion. Among the most frequently cited data needs was getting night count data on the river herring runs.

Coordinator feedback revealed that data is being used in multiple ways to inform decision-making. At the run level, data assists local associations and municipalities with understanding and demonstrating the effectiveness of various restoration activities, such as dam removal. In addition, it helps coordinators and local officials get a sense for what is happening at their runs.

> Recommendation: Continue communicating final count results with volunteers. Failing to communicate results during and at the end of the season may discourage volunteers from participating in the program (Smith et al., 2015). We also recommend coordinators send periodic count updates to volunteers during the counting season.

> Coordinators may want to share best practices with each other on how to train volunteers, set-up sites, or which materials to provide volunteers to minimize data collection errors. In addition, program coordinators should be brought, or brought further, into conversations at the state and regional level about judging data quality and determining which data should and should not be used in specific forms of analyses.

For questions pertaining to this report, contact Karen H. Bieluch at karen.h.bieluch@dartmouth.edu or (603) 568-6076 or Jason Smith at jason.m.smith@maine.edu or (207) 251-1628.

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Acknowledgements

Participants

Association for the Preservation of Cape Cod (APCC), MA
Center Pond Alewife Committee, ME
Damariscotta Mills Fish Ladder Restoration Project, ME
Friends of Herring River, MA
Harwich Conservation Trust, MA
Ipswich River Watershed Association, MA
Jones River Watershed Association, MA
Kennebec Estuary Land Trust, ME
Maine Coastal Program, ME
Massachusetts Bays National Estuary Program (MassBays) and Merrimack Valley Planning Association, MA
Mystic River Watershed Association, MA
North and South Rivers Watershed Association, MA
Orleans-Pilgram Lake Herring Run, MA
Parker River Clean Water Association, MA
Red Lily Pond Association, MA
River Herring Network, MA
Somes-Meynell Wildlife Sanctuary, ME

Introduction

This technical report contributes to a study on volunteer river herring monitoring programs and the use of monitoring data in river herring management in Maine (ME), Massachusetts (MA), and New Hampshire (NH). In this report, we summarize research findings from interviews with people who coordinate a sample of citizen science monitoring programs of river herring in ME and MA and their program successes and challenges; NH was not included in this report due to the relative dearth of citizen science programs in the state. In the concluding section of the report, we offer a set of recommendations for present and future volunteer monitoring coordinators to consider for their programs. This is a collaborative study being conducted by researchers at Dartmouth College (Dartmouth), University of Southern Maine (USM), and University of Maine (UMaine). Interview data summarized in this report includes interviews conducted between June 2014 and August 2014.

The objectives of the citizen science monitoring program coordinator interviews phase of this project are to:

1) Investigate the various attempts at citizen science monitoring of river herring in ME and MA;
2) Collate the successes and challenges associated with starting and maintaining these programs;
3) Produce a set of recommendations or best practices useful to other groups interested in improving or initiating local river herring monitoring programs; and
4) Facilitate the exchange of ideas and resources between program coordinators.

Study Design and Methods

We gathered our data for this study primarily through individual and small group interviews with river herring volunteer monitoring coordinators and co-coordinators. In total, we interviewed 19 volunteer monitoring program coordinators involved in monitoring river herring in ME and MA. We discovered that NH monitoring is primarily conducted by state agents or harvesters, and therefore no data were collected from NH. All face-to-face interviews were digitally recorded and transcribed verbatim and extensive notes were typed during phone interviews.

When analyzing the data, researchers looked for specific themes (Creswell, 2007) related to program organization, run management, factors that enable and inhibit program success, perceptions of data quality, and other best management practices discussed by program leaders.

Researchers also identified themes in the data that emerged through the interviews and were not predetermined during the development of the interview protocol. Data analysis and interpretation are available in the results and recommendations sections of the report. To conduct the coding, each interview transcript was reviewed, analyzed, and coded. During phone interviews, notes were typed during the conversation and much of the conversation was captured verbatim through this note taking method. All face-to-face interviews were digitally recorded and transcribed.

The volunteer coordinator interviews followed 30 interviews conducted in summer 2013 with 14 river herring harvesters in Maine, eight Maine municipal officials, two managers and scientists from the Maine Department of Marine Resources (ME DMR), four individuals involved in river herring restoration projects in Maine, and six members of the Board of Directors for Alewife Harvesters of Maine (AHM). The interviews from summer 2013 were conducted as part of a visioning process for AHM and as part of the groundwork for studying volunteer monitoring programs in ME and MA (Bieluch & AHM Board of Directors, 2014). These interviews helped us understand how the fishery operated in Maine and connected us to key stakeholders working in the fishery, thus helping us design appropriate interview questions for our study. In addition, the interviews followed three focus groups conducted in January and February 2013 that involved citizens and local managers involved in the river herring industry in Maine (Cournane & Glass, 2014). Through the focus groups, researchers from the University of New Hampshire and members of AHM Board gathered baseline data about the Maine alewife fishery. The summary report of the focus groups is available online: http://northeastconsortium.net/pdfs/140322_Summary_Alewife_Focus_Groups_FINAL.pdf. See Appendix B for a detailed description of the study design and methods.

Results: Coordinator Interviews

Program Goals

Interviews revealed that program goals for the volunteer monitoring programs are program specific, and, typically, multifaceted. Above and beyond simply collecting data, coordinators emphasized that their programs helped build river and resource stewardship, assisted with ensuring run success by keeping an eye on the run and alerting people to problems, and educating volunteers, community members and the general public about river herring and the local ecosystem. A second emphasized goal focused on ecosystem and fishery health. For example, several coordinators explained that their programs aimed to restore local ecosystems, including helping bring back a sustainable river herring population. Finally, the third most frequently noted goal for programs was gathering data to support restoration and engineering efforts. For example, programs assisted Associations by collecting pre- and post-culvert replacement or dam removal data to document the need for additional modification and/or to

demonstrate the success of restoration efforts. This latter goal demonstrates the importance of these programs for informing local decision-making. Other goals discussed by coordinators included gathering data with the hope of opening runs for harvest and evaluating currently harvested runs, counting volunteer time as match for grants and using run results to support proposals, and gathering baseline and long-term count data.

Volunteer Recruitment

Coordinators discussed recruitment strategies and recruitment modes used to engage new volunteers, as well as suggestions for content to include in outreach communication. The most frequently cited outreach strategy was reaching out to local organizations, such as watershed groups, to assist with recruitment. Typically, these groups have member lists and often draw on volunteer support to accomplish their work. The goals and activities associated with river herring monitoring programs often align with these organizations and their volunteers as well. Given the mission alignment and the ready pool of volunteers, these organizations can be very helpful in generating awareness of and interest in the volunteer program. A few coordinators also mentioned connecting with teachers and local schools to encourage student involvement, and some indicated that active recruitment was not necessary, as volunteers gravitate toward these activities once they know about them.

The three most frequently cited modes of communication used to recruit new volunteers included: 1) ads or stories in local newspapers (n=9), electronic communication (e.g. email, Facebook, Twitter, organization website) (n=7), and word-of-mouth (n=5). Other interesting recruitment strategies included putting flyers or posters in public places, posting information at the count site, and putting out road signs near the count site.

Finally, several coordinators offered suggestions for the content of recruitment messages, including explaining why the counts are needed and the current "peril" of river herring, emphasizing that counting is fun, and including a story about the run in recruitment messages.

When discussing the kinds of people they target for recruitment, coordinators mentioned members of local nonprofits, such as watershed associations; teachers/professors and students, including elementary, middle, and high school, and college; retirees; people who live around the count site and river herring run; town officials, and recreational fishermen and women.

Smith, Bieluch & Willis (2015) surveyed the individuals who volunteer for river herring monitoring programs. See their technical report for information on volunteers' interest in participating in these programs and how the volunteers reported hearing about the programs.

Training Volunteer Monitors

Content

According to interviewees, the majority focus volunteer trainings on program logistics, such as how to count, where to count, how to use the equipment (e.g. count clickers, thermometers, water depth gauges), and where the equipment is stored. The second most frequently cited content that coordinators review at trainings is fish and site information, such as river herring identification, river herring biology, and run history. A few coordinators also mentioned that they spend time discussing why the data being collected by volunteers is important and how it is used.

Frequency
Training frequency varied greatly by the run. The majority of runs provided an early preseason, in-person group training. Other coordinators conducted multiple trainings, some as a group and some with individuals, to cater to different volunteers' schedules and needs. Programs with interns and/or co-coordinators were more likely to provide individual trainings after the initial group training than programs with single coordinators. See Smith, Bieluch and Willis (2015) for information related to volunteer river herring monitors' experiences with and expectations for training.

Mode
While coordinators discussed a variety of training modes, the majority (n=11) indicated they offer preseason group, face-to-face trainings. Of those who offer group trainings, four specifically said they have at least a portion of the training at the monitoring. Six coordinators said they provide individual, face-to-face trainings, and four of those six coordinators offer training on-site. Individual trainings tended to be reserved for new volunteers, because experienced volunteers do not tend to need training. One program asks an intern to help with the follow-up individual trainings. Alternative training modes included email or web-based trainings using videos and pictures, and peer-to-peer training where experienced volunteers train new volunteers.

Strategies
Volunteer coordinators' strategies for conducting trainings varied by program. There was little consistency in the specific strategies discussed during the interviews, thus, we highlight a few interesting strategies that may be applicable to other programs. For example, if one coordinator is managing multiple runs or a large volunteer pool and his/her time is limited, one coordinator recommended waiting to train individuals as a group, instead of attempting to meet with each n ew volunteer who missed the preseason volunteer training session; this strategy helps protect coordinators' time. Similarly, another coordinator recommended asking new volunteers to attend the coordinator's count slot to receive the training, instead of the coordinator attending the volunteer's count slot. In terms of scheduling, one coordinator recommended holding multiple trainings during a variety of times and days. This may be particularly important when starting a run to maximize recruitment and to build the volunteer pool. Finally, one coordinator recommended identifying experienced volunteers and asking them to help train new volunteers.

This strategy helps counters connect with each other, gives experienced volunteers more responsibility and opportunities for involvement, and reduces time demands on the coordinator.

Volunteer Retention

Just over one quarter of the interviews (n=5) noted that retention is generally high in their programs. For example, one coordinator said that they have an approximately 75% retention rate. When asked to discuss strategies they use to retain volunteers, coordinators provided details about activities before, during and after the season, as well as some general considerations for retention. Several coordinators said that, prior to the start of the season, they send an email blast announcing the upcoming season to volunteers from previous years and then follow-up with direct, personal communication, when needed. Eight interviewees commented on the importance of staying in touch with volunteers, keeping volunteers updated about the run, and being responsive to volunteer needs, questions and recommendations throughout the monitoring season. One coordinator creates a weekly report to update volunteers on the latest count information and to keep them "pumped up" about counting, and another coordinator said that his/her association hosts regular events and potlucks throughout the year to keep volunteers engaged.

During and particularly at the end of the season, coordinators stressed the importance of acknowledging volunteers and saying thank you. A few coordinators give awards to the person who saw the first fish or counted the most fish. Yet, one interviewee cautioned not to give out awards to avoid discouraging people from participating, especially because awards for counting most often or seeing the most fish often go to the same people year after year. Other techniques used for celebrating volunteers include hosting socials at the end of the year, sending thank you emails, and listing volunteers in association annual reports.

Finally, coordinators use specific techniques to avoid unnecessary program attrition, including holding optional trainings for experienced volunteers, making the protocol easy for volunteers to fill out and ensuring the counting equipment is easily accessible. One coordinator explained that s/he tries to get volunteers involved with other activities, such as water quality testing, to strengthen retention.

Despite one's best efforts, there are activities, such as construction at the count site, that are out of the coordinator's control that may harm retention. Yet, there are equally important factors that are natural parts of the program that help keep people involved. For example, coordinators indicated that counting was fun, that the fish are tangible and people get excited about seeing them, and that the count sites are beautiful and people feel good about engaging with and being outside in nature. These are qualities that the coordinator cannot control, but that s/he may certainly capitalize on when discussing and recruiting for the program.

See Smith, Bieluch and Willis (2015) for information related to volunteer river herring monitors' communication needs and intention to participate in future monitoring activities.

Barriers to Volunteer Participation

The most cited barrier to volunteer participation was site access. Remote sites or sites that are challenging to walk were impediments to participants and decreased participation rates. Only one coordinator mentioned that a remote site was positive because it kept knowledge about the run low, potentially preventing poaching. Overall, coordinators indicated preferring a site that is publicly visible, partially for education and recruitment purposes, and one that is easily accessible by the general public.

Site Maintenance and Monitoring

Interviews revealed that maintaining river herring runs requires collaboration from multiple stakeholders, patience, and creativity. Responsibility for water levels and fishway and stream maintenance is often shared by municipalities, nonprofits, and volunteer monitoring programs. These groups work together to manage water levels, maintain fishway passage, address stream barriers (e.g. beavers, debris), and write grants to fund restoration efforts.

The individuals in charge of site maintenance and monitoring vary by program. Typically, the herring warden and/or town alewife/river herring committee is in charge of maintaining the run. In terms of maintenance, these individuals or groups make sure the fish ladder is operational and that the stream is free of debris and other impediments to fish passage. Often, the herring warden or committee is also the liaison for the volunteer monitoring program with town administration. With that said, there are program coordinators who mentioned that their watershed association helped refurbish fish ladders and replace culverts. These associations typically worked in collaboration with municipality and/or state officials on these restoration projects. In fact, dam removal in particular takes significant coordination between public, private, and nonprofit stakeholders, and may take years to decades to achieve.

Herring wardens in some municipalities manage water levels at dam passage sites. In some cases, the Association coordinating the run works with dam owners (e.g. municipality, municipal water district, and/or private owner) to ensure that water levels are sufficient to allow passage. In yet other cases, the coordinator and volunteers take care of the fish ladder and river maintenance, sometimes utilizing AmeriCorps volunteers to help with annual stream maintenance. Several coordinators mentioned that they work with the municipality or municipal committee on proposals for grant applications related to river restoration and monitoring.

One coordinator provided an insightful observation about the relationship between site maintenance and the volunteer monitoring program. This coordinator pointed out that the volunteers are a regular source of information about the structural integrity and operation of the

run. Because they are on-site more frequently than most municipal agents and coordinators, they can alert coordinators or officials in a timely manner when something is not working at the run. Catching a dam malfunction or stream blockage issue quickly may significantly impact the run, as the fish may return to sea or spawn in other locations if migration progress is slowed for too long. One coordinator mentioned that s/he worked with the municipality to develop an operations and maintenance guide. The guide helps ensure each party's needs were accounted for when considering run management.

Finally, maintaining river herring runs takes creativity. During the interview process, we learned about the temporary and permanent structures coordinators, state managers, and volunteers devise to facilitate fish passage. From lowering the slope of a step along a fishway, to directing fish away from natural barriers and toward a passage route, to bucketing fish up and over obstacles, these groups take significant measures to ensure successful migration of this species. Importantly, one coordinator noted that it is important to document when adjustments are made to fish passage so that the managers can monitor which adjustments have and have not worked, and most importantly, which adjustments have hurt fish passage; this long-term documentation of management practices can be used by future leadership to make more informed decisions.

Coordinator Communication

Content
In terms of the content of coordinators' communication with volunteers, coordinators explained that they communicate about several topics with volunteers. For example, the majority of their communication with volunteers relates to: 1) providing run updates, such as the fish arriving, the run ending, and changing water levels and site conditions. 2) Scheduling process, schedule needs (e.g. more volunteers), and schedule changes, and 3) count results or summaries. Coordinators also noted that they communicate with volunteers about events (e.g. trainings or end-of-the year celebrations) to recognize volunteer efforts, to educate volunteers about the program and river herring, and to share stories, news, and photos.

Frequency
When asked to discuss the frequency of their communication with volunteers throughout the year, and specifically during the monitoring season, program coordinators were generally split in their responses. Approximately half of the coordinators noted they had infrequent communication with volunteers during the counting season, and the other half noted weekly, bi-weekly, or "regular" communication with volunteers throughout the monitoring season. Most coordinators mentioned that they send follow-up emails at the end of the season to thank volunteers and communicate final run counts. Some coordinators host an annual event in June or July after the season concludes, and others send an email in late summer or fall with final count

data. Preseason meetings and some form of communication at the close of the season are common across most programs. However, communication during the season and the level of communication with volunteers varies widely by the program.

Mode

We asked coordinators to discuss the modes of communication they use to communicate with their volunteers. Respondents offered a variety of communication modes. The most frequently cited modes of communication were email (n=19), face-to-face group events, meetings, and celebrations (n=10), paper based counting instructions, notes, or counting calendars left on-site for volunteers (n=9), face-to-face communication with individuals or groups (n=7), and newspaper announcements about the run, including program advertisements and stories (n=7).

Results document that coordinators are employing a mixture of electronic and face-to-face communication techniques to coordinate with volunteers. In general, coordinators said that they use email communication throughout the monitoring season to keep in touch with volunteers weekly, or on an as-needed basis. Face-to-face communication seems to primarily occur during early season meetings and trainings, prior to the spring run, and at the end of the season after the counts are complete. Some face-to-face communication occurs incidentally on-site, on an as-needed basis for training, at Association headquarters, or randomly in the local community.

Strategies

Coordinators offered several communication strategies they find effective for program management. The strategy most frequently discussed by coordinators was facilitating communication among volunteers and between volunteers and the program coordinator. For example, coordinators explained that volunteers and coordinators need to communicate about the monitoring schedule. Therefore, coordinators recommended actions the following actions to help facilitate schedule coordination: 1) develop a Listserve to facilitate communication; 2) implement a team-based system whereby team members who are responsible for a specific counting time each day communicate among each other about schedule changes and needs, and 3) make the schedule publically accessible and modifiable.

Coordinators also discussed the following communication strategies: send regular updates to volunteers throughout the monitoring season; start program planning, volunteer outreach, and scheduling early and before the counting season typically begins; ask others, such as an intern or co-coordinator, to help manage the program, especially volunteers' schedules; and host social events to build community, answer questions, and celebrate the season.

Outside of the commonly suggested strategies, individual coordinators made strategy suggestions that may be applicable to other programs. For example, one coordinator suggested inviting guest speakers to encourage attendance at events. Another recommended blind copying

volunteers on emails to protect volunteer privacy, and another interviewee suggested discussing that counting is simple and family/friend-friendly. Finally, one coordinator recommended implementing a feedback system so volunteers can discuss their program experiences.

Roles of Volunteers

To understand the extent of volunteer participation in program operations, we asked coordinators to discuss the various roles volunteers play in their program. Besides the obvious role of counting river herring, we discovered that volunteers play a variety of other critical roles to help ensure fish migration, to communicate data to the appropriate partners, to recruit volunteers, and to ensure funding is available to support restoration efforts. Outside of counting data, the most frequently noted roles played by volunteers included: 1) site maintenance and monitoring, including debris removal from streams, fish ladder repairs, and general stream and dam observations. 2) Data entry, 3) grant writing and/or fundraising, and 4) volunteer recruitment and coordination. Some of these activities (i.e. run maintenance) are coordinated with or assist ongoing herring warden or fish commission responsibilities.

See Smith, Bieluch and Willis (2015) for information on volunteer river herring monitors' interest in various monitoring-related activities. The report indicates that volunteers are interested in more activities than counting fish.

Volunteer Monitoring Data

Data Collection

Coordinators discussed several aspects of data collection, including counting periods, data collection, strategies for organizing monitoring equipment for volunteers, count sites locations, and video monitoring, among other issues. Typically, volunteers in MA count in 10 minute blocks from 7 am to 7 pm. Although coordinators indicated that they try to fill each of these slots, they also recognized that it is challenging to cover all shifts, so they do the best they can and allow volunteers to select the times that work for them. At some runs, interns are able to fill vacant count slots. In Maine, volunteers typically count for 10 minute and 30 minute timeslots from 7 am to 7 pm. Maine is testing the use of 30 minute slots, partially because volunteer pools in Maine communities tend to be lower than those available in MA.

Volunteers from Maine and Massachusetts commonly collect data according to the Massachusetts Department of Marine Fisheries (MA DMF) protocol (Nelson, 2006), as well as equipment available at the run. For example, volunteers typically collect count data, water and air temperature (if equipment is available), animal and human activity on-site, weather conditions (e.g. cloud coverage and rain events), and precipitation. Some runs also ask for water level data and water clarity information. These data help managers understand river herring migration and also provide important data on factors, such as water clarity, that may impact the

quality of the count data. At runs with video monitoring equipment, volunteers or interns may count fish on the video for count slots where data is missing. Interviewees indicated that the video monitoring equipment complemented, but did not replace, volunteer counting. One run lacks a specific passage site and, thus, requests that volunteers estimate the number of fish in a school or cloud at particular pools along the run.

Finally, coordinators discussed strategies for ensuring that the necessary equipment is available for their volunteers. Most sites secure a lock-box, mailbox, or rubber tote on-site so the equipment is always available for volunteers. Other programs with remote count sites may ask participants to pick-up the equipment at an association's headquarters or from a trusted volunteer. Another program purchased polarized sunglasses to help volunteers see the fish.

Data Organization
At the majority of runs, volunteers either fill out data sheets and leave them on site, enter counts in a write-in-the-rain notebook, or keep track of their counts in their own notebooks prior to sending them to the coordinator. In each of these cases, the coordinator compiles the results and either enters them directly into the MA DMF program (available to MA runs), provides the Association for the Preservation of Cape Cod (APCC) with a completed spreadsheet, or communicates the results to state managers using some other format. Three coordinators said that their interns entered the data. In addition, three coordinators explained that their volunteers enter their individual data in either a GoogleDoc or through the online program operated by MA DMF.

Communicating Findings with Volunteers
Although one coordinator indicated that s/he did not communicate the results to volunteers due to time constraints and another said that they never received consolidated results from the state agency (i.e. ME DMR or MA DMF), almost all coordinators communicate the final count results and population estimates to their volunteers at some time and in some format. A couple of coordinators provided count results regularly throughout the season, either through an email, website, or blog. While these weekly updates did not provide a final run estimate, they gave participants a sense of the overall run status for this season. Several coordinators (n = 4) discussed holding a final event at the end of the season for volunteers where run counts and run estimates are shared, and several other coordinators (n = 11) indicated that they send volunteers a final report on the count and run estimate. Some of these coordinators simply forward the final reports from ME DMR, MA DMF, or the APCC. Two coordinators also discussed sharing the results with the herring warden or town so they too know the season results.

Data Needs
In addition to needing more time, more fish, and more volunteers, coordinators offered several suggestions for additional data they would like to see collected. Among the most frequently cited

data needs was getting night count data (n=5). Several coordinators noted frustration with not being able to count at night because they felt their runs were either primarily night runs or that they were missing important data points at night, leading to an underestimation of run size. Other coordinators discussed wanting to understand spawning success and out-migration success of fry (n=3). Several others noted the importance of gathering long-term count, rate of passage, and habitat data (e.g. habitat quality, dissolved oxygen levels, water quality, water turbulence). A few coordinators discussed data needs in terms of data quality. See the Perceptions of Data Quality and Accuracy section for additional details. Finally, two coordinators said that they collect whatever data ME DMR and MA DMF tell them to collect, assuming that the state agencies will guide them on which data is important to collect.

Perceptions of Data Quality and Accuracy

In general, coordinators expressed some concerns with data quality and usability. For example, participants identified conditions that may impact count accuracy, such as poor weather, high numbers of fish passing all at once, volunteers choosing not to count or not taking counting seriously. Several coordinators also expressed concerns with the robustness of the data for drawing conclusion. One coordinator said that the data quality was low, but that it was better than no data, especially for trend analysis. Another explained that there was not enough data at his/her run to draw any conclusions about the run, and another individual noted concerns with the assumptions made in the model to estimate run sizes. Concerns with the data were not universal. Some coordinators did not express any concerns with the quality of the data or thought they had a quality dataset.

Interestingly, a few runs indicated they use, or will use, video monitoring equipment to complement and check volunteer counts. One coordinator explained that they have found that the video and volunteer counts generate essentially the same run estimates, but that the video count confidence intervals were tighter because they were able to have 100% coverage of the counting slots with video monitoring because video provided continuous monitoring and 56% coverage with volunteers on-site because volunteers could not physically be at the site during all available time blocks.

Data Driven Decision Making

Coordinator feedback revealed that data is being used in multiple ways to inform decision making. At the run level, data assists local associations and municipalities with understanding and demonstrating the effectiveness of various restoration activities, such as dam removal, culvert replacement, and fish ladder repairs. In addition, it helps coordinators and local officials get a sense for what is happening at their runs. In Maine, this information is critical for demonstrating the sustainability of a run for harvesting. Some coordinators were not sure how the data informed decisions, but they expressed hope that it helps state managers make

decisions about the fishery. Two coordinators thought the data assisted with long-term monitoring to identify population trends in the fisheries. Finally, a couple participants noted that it took some time and some assistance from the National Oceanographic and Atmospheric Administration (NOAA) to convince state officials to use the data for management decisions.

Coordinator Resource and Collaboration Networks

We analyzed interviews to identify the people, associations, and organizations recognized by coordinators as resources and/or collaborators for their programs. We identified 10 categories of resources and/or collaborators, including: municipalities, state or regional programs or organizations, state-level managers, specific community members or groups, local schools and colleges and universities, federal agencies and nonprofits, local nonprofits and watershed associations, harvesters and fishermen/women, and private individuals or companies. Municipal representatives, such as herring wardens, herring/fish committees, selectboards, and other municipal employees, were the most frequently cited resources and collaborators. If the coordinators are not members of a municipal group, they typically work with municipalities in some fashion to run their programs. The second most frequently cited resource and/or collaborator were statewide or regional organizations, such as the Association for the Preservation of Cape Cod (APCC), the River Herring Alliance, and Maine Coastal Programs. Finally, the third most frequently cited resources included state agencies, such as Maine Department of Marine Resources (ME DMR), Massachusetts Department of Marine Fisheries (MA DMF), and Maine Department of Inland Fisheries and Wildlife (ME IF&W). Often, participants identified individual managers from ME DMR and MA DMF, instead of the organization. Please note that we did not ask participants about program funding resources. Thus, we argue that this is an importance resource category that is missing from this report. A full list of resources and collaborators may be found in Appendix A.

Other Interesting Findings
Technology and Monitoring Programs

Volunteer monitoring programs employ a variety of technologies, ranging from phone communication with volunteers, to email, to Facebook to infrared video monitoring equipment installed on-site. The introduction of technology into monitoring programs is likely to grow as more people come "on-line" and use social media, as programs grow and develop, and as other counting instruments (e.g. video and electronic monitoring) are implemented to either complement or replace volunteer counting. Even if counting instruments are included in a program, the program may still need volunteer counts to help verify the accuracy of the counting instrument.

Simplicity

The theme of simplicity came up several times during interviews and was discussed as an important factor for maintaining the counts and volunteer engagement. Coordinators offered several suggestions for creating a simple process for volunteers. While the full list is not included in this report, the following are the most frequently cited suggestions: 1) keeping the counting process "bomb proof simple" by having a simple protocol, leaving the equipment at a central location (preferably on-site at the count), and by using simple sign-up tools, such as Googledoc. 2) Organizing the counting site in an accessible location, and 3) taking structural steps to help simplify counting, such as putting white sandbags or a whiteboard at the counting site to increase the visibility of fish for volunteers. A couple of coordinators noted that the weather and water conditions can complicate counting by decreasing visibility or inhibiting the run. These are factors outside of coordinator control. However, the coordinator may want to ask volunteers to note such conditions on the data sheets, as they may influence count accuracy, and to stress that even counts of zero are important data points in the dataset. Further, we recommend that coordinators seek volunteer feedback on run management and to identify what volunteers think could be changed to simplify and/or improve the monitoring process.

Role of Local Experts and Local Experts as Scientists
Overall, respondent comments demonstrated the importance of a historical understanding of the runs, community complications, historical tensions over the site (usually dam related), historical ownership, etc. The people we considered "local experts" tended to discuss the historical-cultural conditions of the site in relation to understanding why this site was selected for monitoring, how the run started, and how far the run has come. The local expert can add a lot of energy to a program because of his/her local connections in the community or with the site. Identifying a local expert for a program with whom volunteers can connect and learn from may increase the overall draw to participate in the monitoring program.

Respondent comments demonstrated that coordinators with scientific expertise in ecology, biology, and/or fisheries management are more critical of the data collection, have a solid sense of what the data does and does not tell them, and strategically alter the set-up at run and the methods used to collect data based on a scientific understanding of the process. The people we considered "scientific local experts" tended to discuss the scientific merit and counting and run management methods when discussing run operations and management.

Coordinator Recommendations
When asked to provide recommendations to other program coordinators, interviewees offered several observations. The most frequently noted recommendation for starting and maintaining programs was having quality communication with volunteers. Coordinators explained that they have regular communication with volunteers through such mediums as email and Facebook, and they recommended asking for volunteer feedback on the program and hosting meetings to stay

in communication. Coordinators also made recommendations about recruitment. They suggested that coordinators reach out broadly, but also target certain groups, such as people who shop at fish markets. One coordinator recommended being mindful of when the recruitment begins; s/he stated "People don't care about Christmas in July." The third most frequently discussed recommendation involved education and training. Coordinators discussed the importance of not only explaining how to count and how to sign-up for counting slots, but also why monitoring is important. Other noteworthy recommendations included starting planning early, finding a core group of volunteers when starting the run, offering an incentive, such as a gift card or t-shirt, for the person who counts most often, making the process simple and centralized, and making sure to use technical resources, such as APCC and state and federal agents, to answer questions as they arise. Two other coordinators offered the following sound advice, "Don't get frustrated," and "This needs to be a team effort."

Recommendations Based on All Interviews

Based on the interview findings, the following recommendations are offered:

Program Goals:
While regional and federal managers may be interested in the count data for coastal stock assessments and decision-making on a coastal scale, river herring count data informs local and state decision-making in important ways, which may have ramifications for the coastal system. When evaluating the success and importance of these citizen science programs, it is critical to monitor interactions between local and regional scales. Since each volunteer participates for multiple reasons (Smith et al., 2015), it is important to publicize all goals to enhance volunteer identification with the program and learn how they can further support or partake in the management process of river herring.

Program Recruitment:
Our research on volunteer river herring monitoring programs revealed that local nonprofits, particularly those with missions related to the local ecosystem or watershed, are central actors in promoting and coordinating river herring monitoring programs. Not only do they assist coordinators with developing the volunteer pool for counting, they are also often the lead coordinators for these programs. The associations provide the organizational structure and resources to recruit, run, and manage volunteer programs and grants for river restoration, and they also often provide expertise on river restoration and watershed ecology. If a run is not already connected with a local organization, we recommend that coordinators explore collaboration opportunities within their watershed by directly contacting their local organizations. Associations are often interested in further connecting their programs to new efforts to strengthen their capacity and outreach. In addition, we recommend that coordinators

use a variety of paper, face-to-face and electronic communication tools to recruit a diverse volunteer pool. If one of the goals of the monitoring programs is to promote stewardship of the local resource, engaging a diverse group of volunteers in the program is one strategy for ensuring community support for the resource and for involving volunteers who contribute an assortment of skills to the program.

Recruitment Messaging: Recruitment messages are most effective when tailored to specific audiences. For example, when posting with senior groups, make sure to explain whether or not the count site is accessible, or when communicating to youth groups make sure to suggest that the time may be counted toward community service graduation requirements. Taking time to understand group interests and needs will help coordinators craft messages that speak to their target audiences. Asking volunteers to review and react to messages may help coordinators develop messages that resonate.

<u>Monitoring Training:</u>
Content: A critical component of volunteer training is training them how to accurately count river herring. Trainings may also contribute to volunteer participation frequency, their confidence, and feelings of preparedness while counting. However, coordinators may also want to take the training opportunity to provide volunteers background information on river herring (especially how to differentiate them from other fish species) and to explain the importance of the data and how it is used. A recent survey of volunteer river herring monitors revealed that participants felt that communicating information about the way in which data is used and how the program is accomplishing program goals were factors that positively influenced volunteer participation and retention (Smith et al., 2015). Explaining the goals of the program may help motivate volunteers to help meet them, and understanding data use may strengthen data collection because volunteers will have a better sense of why, for example, a count of zero is a usable data point or why counting run backs as those still migrating to spawn may be problematic for generating accurate run estimates.

Frequency: Volunteer training sessions are key to the success of a program. Assuring volunteers feel comfortable at the site and with the methods and goals of the program can directly affect the quality and quantity of the data. Since volunteers' work schedules are not uniform (Smith et al., 2015), volunteers will have different amounts of time to dedicate to volunteer training, meaning one volunteer may want and need to meet more than another to feel comfortable and prepared to count. Volunteer coordinators should be prepared for this and know their own availability and resources to facilitate volunteer training. See the Training Mode section to identify training mode options and resources.

Mode: Group, face-to-face trainings seems to be the most frequently used trainings, with individual trainings for new participants or participants who were unavailable during the group

session. Using these two modes of training seems important for helping create a volunteer community, providing important program information, and answering participant questions. We recommend providing paper instructions for counting on-site and following-up with volunteers via email or social media (e.g. Facebook) throughout the monitoring season. Follow-up communication may include, for example, sending a picture comparing a bass versus an alewife, providing suggestions for counting in-migrating versus ex-migrating fish, or providing other pertinent information, such as on-line training videos from other count sites. These strategies reinforce the training and may strengthen the overall quality of the data through continued education that may help improve overall counting accuracy by providing procedure reminders and information that addresses questions that arise during counting.

One convenient training option is volunteer-volunteer trainings. Experienced volunteers may be interested in expanding their program involvement, and asking them to show other volunteers how to access the site and conduct counts may fit with their volunteer goals and interests.

<u>Volunteer Retention:</u>
Retaining volunteers can be challenging because of life circumstances that bring people into and out of programs and because of the significant gap of time between counting seasons. There are several steps coordinators may take to ensure program retention. First, coordinators should consider reaching out to former volunteers early and, when necessary, directly. Second, coordinators should consider having regular contact with volunteers before, during, and after the counting season to keep them engaged and demonstrate appreciation. Finally, coordinators may want to consider hosting at least one special event during the year to bring volunteers together, to answer questions, and to demonstrate appreciation for their involvement. These techniques seem to be effective strategies used by the coordinators interviewed for this research.

<u>Barriers to Participation:</u>
The location of the count site is an important aspect of a monitoring program because the location influences participation. Furthermore, site configurations (e.g. distance from the water, total width of the tributary, slope of the fish ladder) impacts visibility of the fish, thus potentially influencing the accuracy of the counts.

When identifying locations to count, make sure that the site is accessible to people of all age groups. Consider safety and handicap accessibility as well. If one needs to count in a remote location, communicate the challenges of access openly and try to recruit people you know can access the location, even during variable weather (e.g. rain) and water (e.g. high flow) conditions. Promoting team counting, such as seniors counting with their children and grandchildren or kids counting with their parents, may increase safety at certain sites and strengthen participation from people of all age groups. In addition, touch base with volunteers to identify additional equipment (e.g. polarized sunglasses) that may improve their ability to accurately count fish.

Site Maintenance and Monitoring:

Groups involved in river herring run maintenance and monitoring should map out which parties are responsible for which aspects of run maintenance and monitoring. Openly communicating about needs and resources for maintenance should help diminish frustration between parties and enhance coordination at the runs. In addition, collaborating may strengthen grant proposals and restoration efforts. Finally, we recommend that coordinators document all changes to fishway for future reference and provide to volunteers a list of contacts of the people in charge of various aspects of site maintenance so volunteers know whom to call if something is not working on-site. Coordinators could leave the contact list on-site with the counting equipment so the list is available to all participants.

Coordinator Communication:

Content: Evaluating communication is important in program management. Communication may include type, frequency, content, adequacy and effectiveness, as well as communication needs. As coordinators evaluate their communication with volunteers, we encourage them to think about what they are communicating to volunteers, why they are sharing that information and how, and what kinds of communication volunteers need or desire. One approach will not work for all programs. However, as recognized in coordinators' discussions of communication content, there is some basic information that volunteers need, such as run updates, count scheduling, event details, count results, and run population estimates. Volunteer recognition and education are also important for volunteer retention and for data quality, respectively.

During the counting season, communication may focus on asking volunteers specific questions, including asking them what problems they are experiencing while counting, or if they are able to bring a friend, and asking them to share a short description of what they experienced while counting. Explain to the volunteers that you want to share this information with other volunteers in the form of a general announcement about the run. It is important to acknowledge that coordinator time is typically scarce during the spring migration period. However, focusing just one or two emails around volunteers and their experiences during this time span may contribute to the overall sense of community of the volunteer pool, and that sense of community may contribute to the longevity of the volunteer program.

Frequency: Program coordinators should be mindful of the need to communicate with volunteers at least intermittently throughout the monitoring season. Communicating once at the start of the run and once at the end of the run may negatively impact volunteer engagement. In addition, failure to touch base with volunteers after the count begins may impact count accuracy because counting issues may not be dealt with in a timely manner, or volunteers may have questions

about counting that go unanswered. Opening the lines of communication with volunteers may assist with volunteer retention and data quality.

Mode: Results document that a one-size fits all approach to communicating with volunteers is not effective. Communication is volunteer specific (e.g. some people avoid, cannot use, or do not have access to technology) and coordinator and resource dependent (e.g. how much time does the coordinator have to visit people on-site? Do interns assist with the monitoring program?). Thus, when considering communication techniques, one must take into account the needs and wants of the volunteers and coordinator capacity for communication. Face-to-face communication may be more time intensive, yet it tends to yield important interpersonal and community-building results and can alleviate problems early in the counting season by providing an opportunity for question asking and demonstration. Email communication typically is less time-intensive, but, depending on the volunteer pool, it may not provide interpersonal connections that build a sense of community among volunteers. With that said, communication research documents that one can build a sense of community through online communication forums as well. Coordinators' approach to communication should be flexible and adaptable.

Strategy: Coordinators identified numerous strategies for promoting communication among program participants. We recommend the coordinator try different strategies for facilitating communication until he/she finds one that works for his/her program. Again, asking volunteers for suggestions and feedback will help ensure that the selected strategies align with volunteers' abilities and needs.

Interestingly, while the frequency of coordinators' communication with volunteers varies by program, several coordinators cited "regular" communication as a key communication strategy in their programs. Essentially, the coordinators argued that it is important to communicate with volunteers throughout the monitoring season, although what that communication looks like will likely vary by program. It is up to the volunteer coordinator and his/her respective volunteers to determine what "regular" means for their program. For programs that have the resources and needs, it does seem that dividing duties, particularly scheduling and volunteer coordination duties, between co-coordinators or a coordinator and interns, helps reduce the time demands on the coordinator and fosters stronger communication among parties involved in the programs. Co-coordinators and interns may include people who work part-time, retirees, AmeriCorps volunteers, and college students who desire work experience.

Roles of Volunteers:
One of the key lessons we learned from coordinator interviews and our survey of volunteer monitors is that volunteers bring to these programs a wide range of expertise, interest, and availability (Smith et al., 2015) that, if utilized by the coordinators, can add depth and scope to river herring monitoring programs. With some notable exceptions, the majority of programs ask

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volunteers to collect data, attend specific training and end-of-the year events, and keep an eye on fishway functioning. While these functions are critical to program success, the volunteer pool may be expanded and the program improved when volunteers are given opportunities to participate in activities such as repairing the fishway by installing new baffles, communicating count results to other volunteers and at town and state forums, entering count data and conducting analyses on that data, identifying new questions to study about the run, and writing grants and hosting events to sponsor restoration efforts. The majority (78%) of volunteers who responded to our survey were interested in extending their participation in the program beyond counting (Smith et al., 2015). Although responding to that interest will require coordinator time, in the long run the coordinators may find that their time investment will decrease because more volunteers will take leadership roles.

Coordinators discussed several interesting models of volunteer involvement that are noteworthy. Even if the current volunteer pool is small, these models may help generate ideas for expanding volunteer participation and ownership of the program. For example, at one run, the coordinator recruits team captains and the captains are responsible for recruiting and training volunteers to cover specific count slots, and for schedule adjustments and volunteer communication. Another program implemented a co-coordinator arrangement, where one coordinator is in charge of technical program details, such as trainings, communicating with partners, and overall program management, and the other coordinator is in charge of volunteer communication and scheduling. This arrangement reduces the time burden on any single individual and it also allows these two volunteers to play roles that align with their individual strengths. Finally, another program hires interns to assist with various aspects of the programs, including volunteer trainings, schedule coordination, and filling open count slots.

Data Collection, Communication, Use, and Needs:
Collection: Programs should continue to collect consistent forms of data across sites and states. Standardizing data collection improves managers' abilities to create stock assessments and assess population health. Volunteers are currently collecting a variety of data. As long as the data is valuable, it seems reasonable to ask them to continue collecting such data. In addition, offering volunteers an opportunity to share counting experiences, such as observations of wildlife, on the data sheet or, for example, on an online blog provides volunteers an important forum for documenting observations and for sharing run connections. If shared publically, these experiences may also be learning opportunities for other volunteers.

Communicating Results: Continue communicating final count results with volunteers. According to the results from the survey of volunteer river herring monitors, a failure to communicate results at the end of the season and during the season may discourage volunteers from participating in the program (Smith et al., 2015). Thus, if time permits, we also recommend

coordinators send periodic count updates to volunteers during the counting season. One coordinator expressed concern that data shared too early may mislead volunteers into thinking the run is doing better or worse than it is. While this is a valid concern, especially because many volunteers are not familiar with run estimations and statistical modeling, the benefits of data sharing in terms of retention and engagement may outweigh the risks associated with data sharing. Afterall, the end of the year summary and explanation should provide clarification on overall run health.

Data Accuracy and Usability: Coordinators may want to share best practices with each other on how to train volunteers, set-up sites, or which materials to provide volunteers to minimize data collection errors. In addition, program coordinators should be brought, or brought further, into conversations at the state and regional level about judging data quality and determining which data should and should not be used in specific forms of analyses.

Other Interesting Findings:

Technology: When considering implementing technology to coordinate schedules, provide run information, or enhance run counts through technology, it is important for coordinators to check their assumptions about volunteers' comfort with technology by asking volunteers about their preferred modes of communication and their perceptions of new counting technology. For example, do not assume that older volunteers are not comfortable with email or Facebook. While their overall levels of experience with new technologies may be lower than those of younger generations, email and internet use are widespread. In addition, when considering implementing technology, such as video monitoring equipment, educating volunteers about why it is being used may help assuage concerns that the counting equipment is replacing volunteers and may help explain how the program is working to address important volunteer concerns (e.g. missing the night run in counting). If coordinators plan to replace volunteer counting with electronic or video counting, coordinators should consider the impacts of this choice on river stewardship and monitoring and community involvement. Prior to stopping volunteer counts, one option coordinators may want to consider is identifying ways volunteers can contribute to river or even watershed stewardship in place of counting river herring. This approach maintains your volunteer pool in case volunteer counts are needed in the future, especially if the technology fails or is determined inadequate for counting.

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Appendices

Appendix A

Interviewees Resource and Collaboration Networks

American Rivers
Association for the Preservation of Cape Cod
Bass River Gun Club
Bates College students
Bostic Corporation
Boy scouts troops
Cape Cod Commercial Fisherman's Alliance
Cape Cod National Seashore
Church groups
College students
Community members
Conservation Commission
Essex County Greenbelt Association
Families
Federal Energy Regulatory Commission
Fish/herring/alewife commission/committee
Fishermen
Frenchman's Bay Alliance
Girl scouts troops
Gulf of Maine Council
Gulf of Maine's Habitat Restoration
Harvesters
Herring Warden
High school students
Kennebec Estuary Land Trust (KELT)
Lobstermen
Local schools and school groups
Local watershed groups
Maine Coastal Program
Maine Corporate Wetlands Restoration Partnership

Maine Department of Marine Resources
Maine Inland Fisheries and Wildlife
Maine Seagrant
Massachusetts Bays National Estuary Program (MassBays)
Massachusetts Department of Marine Fisheries
Massachusetts Division of Ecological Restoration
Massachusetts Division of Natural Resources
Massachusetts Riverways Program
Municipality officials
National Oceanographic and Atmospheric Administration
Natural resources manager (municipal-level)
Naturalists
New England Fishery Council
Nonprofits
Pemaquid Watershed Association
Poets
Private companies
Private dam owners
Property owners around dams
River Herring Alliance
Scientists
Selectboard
Teachers
Trout Unlimited
University of Maine
University of Southern Maine
US Environmental Protection Agency
US Fish and Wildlife
US Fish and Wildlife
US National Park Service
Water district
Wells National Reserve (US Fish and Wildlife Service)
Workers and retirees
Wright Pierce Environmental Engineering Firm

Appendix B

Detailed Study Design and Methods Description

We gathered our data for this portion of our study primarily through individual and small group interviews with river herring monitoring program coordinators. In total, we interviewed 19 individuals involved in river herring monitoring coordination.

We developed the coding themes and subthemes using a sample of interviews. Once two researchers agreed on the themes and subthemes, we applied the coding instrument to all transcripts. All interviews were first coded deductively. In other words, when analyzing the data, researchers identified specific themes that aligned with the major topic areas identified during the coding instrument development phase (Creswell, 2007). A few additional themes emerged while coding the full set of interviews, and those themes were added to the coding instrument. In addition to analyzing the data for specific patterns or themes, we conducted data interpretation to explore the implications of the findings (Glesne, 2006). Data analysis and interpretation is available in the results, recommendations, and observations sections of the report. While we did not run intercoder reliability statistics to verify the coding alignment between researchers (Creswell, 2007), we used an extensive coding instrument development process to reach agreement about the themes and subthemes and their meanings, helping ensure intercoder reliability. In addition, reviewers divided the transcripts for coding, and one of the reviewers reviewed all coding prior to starting analysis to verify consistency between reviewers. Significant discrepancies and questions were discussed prior to finalizing the codes.

To conduct the coding, each interview that was digitally recorded was reviewed, analyzed, and coded. Detailed notes from phone interviews were also analyzed and coded. During phone interviews, notes were typed during the conversation and most of the conversation was captured verbatim through this note taking method. After the initial round of coding, reviewers revisited the initial codes and major themes were broken into subthemes. The categorization of data was then reviewed for accuracy prior to writing up the findings.

The volunteer coordinator interviews followed 30 interviews conducted in summer 2013 with 14 river herring harvesters in Maine, eight Maine municipal officials, two managers and scientists from the ME DMR, four individuals involved in river herring restoration projects in Maine, and six members of the Board of Directors for Alewife Harvesters of Maine (AHM). In addition, the interviews followed three focus groups conducting in January and February 2013 that involved

citizens and local managers involved in the river herring industry in Maine; the focus groups were coordinated by researchers from the University of New Hampshire and members of AHM Board.

Appendix C

Interview Questions

During the interview, we want to learn about the monitoring program you help coordinate, your suggested best management practices for organizing the monitoring programs, the folks with whom you collaborate on the run, and your perspective on the goals and successes of volunteer monitoring for river herring sustainability.

Start of the Interview

If at the run, give participants time to explain the run to you and show you around.

1. Tell me a little bit about your run, such as the location. Do a lot of people visit the site, other than volunteer monitors? (e.g. school groups, community members, etc.)
2. Was there any particular reason you chose this site for monitoring? Does it seem to work well for the volunteers?
3. This sounds like a neat run....how did you got involved in the monitoring program, and when did you became the coordinator?

Now I'd like to ask you a few questions about your monitoring program and the strategies you use to coordinate the efforts. One of our goals with this research is to develop a set of best practices and suggestions for folks interested in starting a program or for those looking to improve their programs.

4. Will you walk us through your monitoring process? For instance, what does the beginning of the year or preparing for the run look like? What kinds of activities take place during the monitoring season? How about at the end of the season?
5. In terms of training, what kind of training do you provide volunteer monitors? (Individual/group/continuous)
6. Do you ask the volunteers at your run to measure inspect anything other than the amount of fish passing, like other environmental conditions (water temperature, measure inspect water quality, remove debris, address beaver dam issues, etc.). How about activities such as removing debris from dams or rebuilding fish ladders?
   6a. Is there a data collections sheet available for the volunteers to use to collect or keep track of this information or activities?
   6b. Along similar lines, are volunteers involved in other stages of the monitoring program, such as grant writing or data analysis?
   6c. If not, how might you see them involved more than they are now?

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7. We have heard from some folks and have read that retaining volunteers can be challenging. Do you have any recommendations for others on how to keep volunteers active over the long-run…or for what not to do?

We are interested in the communication between you and the volunteers.

8. Will you tell us the methods or strategies you use to communicate with the volunteers, such as the mode of communication and frequency during the different stages of the monitoring program?
   8a. Do the volunteers receive consolidated results about the run?

9. If you have had the opportunity to, will you share how you've adapted the program or your monitoring process based on volunteer feedback?

Now we'd like to ask you a few questions about your program goals:

10. In your opinion, what are the key goals for your monitoring program? Is harvesting one of the goals, or does that get discussed by the group?
    10a. Do you get the sense that volunteers understand the goals? Can you think of specific things that you do to help them understand the goals of the work?

11. In your opinion, is your current effort enough to effectively meet your monitoring program goals?
    11a. Do you feel you need additional data to assess the sustainability of your run? Such as…

12. In your opinion, in what ways, if any, are these citizen science efforts helping protect the resource?

13. Finally, in your experience as coordinator, what would you say are the top 2-3 challenges you've encountered doing this work, and what strategies have you used to overcome those challenges?

14. Is there anything I didn't ask that you'd like to add or discuss?

15. We are planning on conducting a survey of citizen scientists to better understand….would you be willing to forward a survey link to your volunteers once the survey is ready to be taken?

    Thank you for your time!

Appendix D

Informed Consent Forms

INFORMED CONSENT

You are invited to participate in a research project led by researchers from the University of Maine (UMaine) and University of Southern Maine (USM). We are working on a research project to improve the understanding of the development of river herring monitoring programs in Maine (ME), Massachusetts (MA), and New Hampshire (NH). We are also studying the use of data gathered by citizen scientists in state and federal fishery management. Participation in this study is voluntary, and you must be at least 18 years old to participate.

This study is being conducted by Karen H. Bieluch, Research Associate, Department of Communication and Journalism, University of Maine, and Theo Willis, Research Scientist, Department of Environmental Sciences, University of Southern Maine. The study is funded by the National Fish and Wildlife Foundation.

What will you be asked to do?

If you decide to participate in the interview, you will be asked a set of questions and will also have the opportunity to ask your own questions. Information we ask you may include questions such as, "In terms of coordinating the volunteer efforts, what do you view as the practices that have led to your group's success with monitoring and coordinating volunteers?" and "Are there certain things you'd like to improve? If so, will you tell me about them?" and "What do you view as the benefits of doing this work?"

You will be asked permission to be digitally recorded to ensure we capture the full details of the conversation. We will later transcribe the recording. If you prefer not to be recorded, we will take detailed notes instead.

Confidentiality

The information you provide will be treated as professional confidences. No information, which might directly identify you, will be presented in any research reports or communications. Your name will not be associated with the interview data. Pseudonyms will be assigned to each participant. The electronic key associating the pseudonym with the participants' real names will be kept on password-protected computers of project researchers, and will be kept for seven

years or until analysis is complete. In some reports, such as our technical report, we will list the names and locations of the runs about which data was gathered. Run names (e.g. Bristol Mills Run) will not be associated with observations and comments in research and technical reports.

All electronically recorded notes taken during and after the interview, as well as the digital audio recordings, will be typed and downloaded and kept on password-protected computers of project researchers, and physical notes from the interviews will be kept in investigators' locked offices at UMaine and USM. Audio recordings will be deleted from the recording device after downloaded to the password-protected computer. Data will be retained indefinitely for the purpose of future research or until data analysis is complete.

Benefits

Although there may be no direct personal benefits to you, we anticipate that the benefits of this study to you and others will be 1) improved knowledge of the Alewife fishery in Maine through our research reports and presentations, and 2) improved networking among volunteer coordinators and programs, harvesters, managers, and municipal officials. If achieved, these outcomes will help promote a sustainable river herring fishery.

Risks

Except for your time, there are no foreseeable risks to you in participating in this study.

Voluntary

Participation is voluntary, and you may skip any questions you do not wish to answer. If you choose to take part in the study, you may stop at any time or request that the researcher turn off the recorder during periods of time in the discussion.

Contact information

If you have any questions, comments, or concerns about the study, please contact:

Karen Hutchins Bieluch, I.PhD   Theodore "Theo" Willis, PhD
Research Associate   Research Scientist
University of Maine   University of Southern Maine
Department of Communication & Journalism   Department of Environmental Science
5724 Dunn Hall, Room 416   106 Bailey Hall, 37 College Avenue
Orono, ME 04469   Gorham, ME 04038
(603) 568-6076   (207) 780-5065
karen.hutchins@umit.maine.edu   theodore.willis@maine.edu

If you have questions about your rights as a research participant, please contact:

Gayle Jones

Assistant to the University of Maine's Protection of Human Subjects Review Board
University of Maine
(207) 581-1498
gayle.jones@umit.maine.edu.

Appendix E

UMaine Institutional Review Board Study Approval

APPLICATION FOR APPROVAL OF RESEARCH WITH HUMAN SUBJECTS
Protection of Human Subjects Review Board, 114 Alumni Hall, 581-1498

PRINCIPAL INVESTIGATOR: Karen Hutchins Bieluch
EMAIL: karen.hutchins@umit.maine.edu TELEPHONE: (603) 568-6076
CO-INVESTIGATOR(S): Theo Willis (University of Southern Maine), Jason Smith (University of Southern Maine),
Laura Lindenfeld, Linda Silka, Bridie McGreavy
FACULTY SPONSOR (Required if PI is a student):
TITLE OF PROJECT: Citizen Science and Collaboration: Ensuring a Sustainable River Herring Harvest

START DATE: ~~6/12/2013~~ 6|18|14   PI DEPARTMENT: Department of Communication & Journalism
MAILING ADDRESS: 5722 Dunn Hall, Room 416 Orono, ME 04469
FUNDING AGENCY (if any):   National Fish and Wildlife Foundation
STATUS OF PI:
        FACULTY/STAFF/GRADUATE/UNDERGRADUATE Faculty

1.   If PI is a student, is this research to be performed:

        ☐   for an honors thesis/senior thesis/capstone?   ☐   for a master's thesis?
        ☐   for a doctoral dissertation?   ☐   for a course project?
        X   other (specify)   Summer research & post-doctoral fellowship starting on 9/1/2014

2.   Does this application modify a previously approved project? Y. If yes, please give assigned number (if
      known) of previously approved project: 2013-06-13

3.   Is an expedited review requested? Y.

SIGNATURES: All procedures performed under the project will be conducted by individuals qualified and legally
entitled to do so. No deviation from the approved protocol will be undertaken without prior approval of the IRB.

Faculty Sponsors are responsible for oversight of research conducted by their students. By signing this application
page, the Faculty Sponsor ensures that he/she has read the application and that the conduct of such research will be
in accordance with the University of Maine's *Policies and Procedures for the Protection of Human Subjects of
Research.*

_____   _____   _____
Date   Principal Investigator   Faculty Sponsor

               _____   _____
               Co-Investigator   Co-Investigator
****
FOR IRB USE ONLY   Application # 2014-06-13   Date received 6/5/14   Review (F/E): E
                                                                        Expedited Category: _____

ACTION TAKEN:

 ✓   Judged Exempt; category 2 . Modifications required? Y (Y/N) Accepted (date) 6/18/14
____ Approved as submitted. Date of next review: by _____. Degree of Risk: _____
____ Approved pending modifications. Date of next review: by _____. Degree of Risk: _____
      Modifications accepted (date): _____.
____ Not approved. (See attached statement.)
____ Judged not research with human subjects

      Date: 6/15/14   Chair's Signature: Cynthia A. Erdley   12/2012

Appendix F

Author Information

Dr. Karen H. Bieluch

Karen Bieluch is the Practice-based Learning Specialist in ENVS. Her research examines community-university partnerships, citizen science, environmental communication and behavior, and place and community identity. As a Learning Specialist at Dartmouth, she collaborates with faculty and staff in ENVS and groups in the Dartmouth and Upper Valley communities to further integrate practice-based learning opportunities into ENVS academics. Karen supports community partnerships and research in the Africa Foreign Study Program, and she also helps students with internships, career development, and independent work and research. Karen earned her Interdisciplinary PhD in communication and sustainability science from the University of Maine in 2013.

Jason Smith

Jason Smith is a master's student in the Muskie School of Public Service at the University of Southern Maine where he also earned his undergraduate in Environmental Planning and Policy in the Department of Environmental Science. His research experience includes sustainable materials management and social aspects volunteer-based ecological monitoring. Along with finishing up this research, he currently works with the Casco Bay Estuary Partnership examining the programs potential role in a regional freshwater quality monitoring network and the possibility of developing living shorelines as a management technique on Casco Bay's coastlines.

Dr. Theodore "Theo" Willis

Theodore "Theo" Willis is an adjunct faculty member and researcher with the Department of Environmental Science at the University of Southern Maine. Theo has a Ph.D. in Limnology & Oceanography from the Center for Limnology at the University of Wisconsin-Madison. In 2005, Dr. Willis began studying the interactions between smallmouth bass and alewife. In 2006, Theo developed an adjunct association with the Dept. of Environmental Science at the University of Southern Maine and the School of Marine Sciences at the University of Maine. Through these associations Dr. Willis developed a restoration ecology program focused on anadromous fish in Maine. His projects included restoration evaluation, molecular genetics, fish mark-recapture, food web ecology in the Gulf of Maine and Maine rivers, elver migration timing, alewife population dynamics and demographics and river herring passage/ swimming abilities. His current projects include interaction between alewife restoration, management, the alewife fishery and citizen science. He also works with Maine indigenous peoples on diadromous fish restoration.