
Aquatic Invasive Species Outreach to Boaters and Anglers in the Lake Ontario Basin



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EXECUTIVE SUMMARY

It is well established that the actions of recreational resource users, such as anglers and boaters, can lead to the spread of invasive species between aquatic ecosystems. States and provinces in the Great Lakes region have developed outreach efforts to discourage anglers and boaters from behaving in a way that can contribute to this spread. Numerous agencies and organizations are involved in this outreach work. The degree to which these efforts succeed depends in part on which agencies and organizations become involved, the capabilities that they have, and the compatibility of their activities. What messages are different organizations communicating about invasive species prevention? Are they communicating similar messages and using similar language? Are they communicating inconsistent messages? Are the organizations that are best able to reach and influence recreational users involved in communicating these messages? Are sufficient resources available to take the actions deemed necessary?

We studied how government and nongovernmental organizations operating at the federal, state/provincial, and regional level attempt to encourage behaviors in anglers and boaters that will reduce the spread of invasive species. In particular, we:

- Identified organizations engaged in aquatic invasive species (AIS) outreach in the Lake Ontario basin;
- Characterized the outreach efforts of these organizations, including the groups they target, the messages they communicate, the outreach strategies they utilize, and the perceived effectiveness of their work;
- Identified the factors that these organizations believed influenced their capacity to engage in outreach work; and
- Characterized the interactions that take place between these organizations and how they were related to the consistency of messages across organizations.

Our research consisted of three components:

- **Telephone interviews.** We conducted 35 semi-structured, individual interviews with representatives of organizations working on AIS outreach in the U.S. and Canadian portions of the Lake Ontario basin. The purpose of the interviews was to collect information on the organizations' AIS outreach programs and on factors that influenced their implementation of those programs.
- **Document analysis.** We gathered educational outreach materials related to AIS targeting recreational users in the Lake Ontario basin and conducted a content analysis of these materials. In specific, we identified messages communicated to recreational users that were intended to encourage them to adopt behaviors to reduce the spread of invasive species. These materials were gathered from those organizations targeted during the telephone interviews.
- **Web-based survey.** We conducted a survey of the same individuals who we interviewed during the telephone interviews. The survey was designed to: (a) collect standardized data on each organization's AIS outreach program; and (b) gather information on the interactions between organizations working on these outreach efforts (referred to as "social network data"). The social network data allowed us to assess similarities and

differences in the organizations that our respondents interacted with (by working together, sharing information, etc.) in the course of their work on AIS. We hypothesized that respondents who tended to interact with the same organizations would communicate more similar messages in their outreach to boaters and anglers.

Results are organized into four sections:

- An overview of outreach programs and messages (based on the survey data);
- An analysis of outreach messages (based on the document analysis of outreach materials);
- An assessment of the effectiveness and capacity of outreach programs (based on the interview data); and
- An analysis of social networks and their influence on outreach (based on the survey data).

This report is closely related to several other reports on aquatic invasive species outreach efforts that we will be releasing in the near future. These reports describe:

- A study of how anglers in Illinois, Indiana, Michigan, New York, Ohio, and Wisconsin have responded to regulations and recommendations intended to reduce the spread of AIS and fish pathogens (Connelly et al. 2014b).
- A study of how bait dealers in Indiana, Michigan, New York, Ohio, Ontario, and Wisconsin have responded to regulations and recommendations intended to reduce the spread of AIS and fish pathogens (Connelly et al. 2014c).
- A study of how boating facilities, bait dealers, and angler and boating organizations have contributed to AIS outreach efforts in the Lake Ontario basin (Connelly et al. 2014a).

Overview of Outreach Programs

The 35 respondents to our survey had outreach programs that attempted to influence the behavior of different audiences to prevent the spread of AIS:

- 66% had programs targeting boaters.
- 63% had programs targeting anglers.
- 71% had programs targeting other groups that may include people who boat or fish.
- 77% (27 individuals) had programs targeting at least one of these three groups.

Our remaining results pertain only to those 27 respondents who tried to influence the behaviors of boaters, anglers, or other groups that may include people who boat or fish.

We asked respondents how much emphasis they placed on each of 10 potential messages about AIS. At least three-quarters of the respondents placed *a moderate or great deal of emphasis* on 6 of the 10 messages:

- Drain all water-holding compartments including live wells, bait wells and bilge areas. (92% placed a moderate or great deal of emphasis on this message.)

- Inspect fishing and boating equipment for attached aquatic plants and animals (89%).
- Remove any visible mud, plants, fish or animals before transporting fishing or boating equipment (89%).
- Report sightings of aquatic invasive species (85%).
- Dry boats, trailers and all fishing or boating equipment before use in another water body (78%).
- Learn to identify aquatic invasive species (78%).

The 3 messages that received a moderate or great deal of emphasis by fewer than half of respondents were:

- Do not pass through aquatic plants in your boat (44%).
- Use only locally bought bait (41%).
- Run your boat engine after you remove it from the water (33%).

We also asked how much emphasis was placed on an additional 6 messages pertaining specifically to what should be done with unused live baitfish. These messages were less frequently communicated, in part because not all outreach programs were concerned with baitfish. Three messages received *at least some emphasis* by more than half of respondents:

- Unused live baitfish may be disposed of on dry land (59% placed at least some emphasis on this message).
- Unused live baitfish should not be thrown into a body of water other than the water where you caught them (54%).
- Unused live baitfish may be disposed of in the trash (52%).

These messages emphasized safe disposal of baitfish as well as what *not* to do with baitfish. The remaining 3 messages received *no emphasis* by approximately two-thirds of respondents. These messages were concerned with the release or reuse of baitfish.

- Unused live baitfish may be thrown back into the water where you caught them (65% placed no emphasis on this message).
- Unused live baitfish may be given to other anglers to use (67%).
- Unused live baitfish may be taken home (67%).

More than 70% of respondents used the New York Invasive Species Clearinghouse (NYIS.INFO) as a source of information in their work on AIS at least several times a year. More than 30% used it at least once a month.

Analysis of Outreach Messages

We identified and analyzed 72 discrete outreach materials used in the Lake Ontario basin. Only 36% of the materials listed the year in which they were published or updated. Of these materials, 89% were developed or updated within the last 10 years, and 63% were developed or updated within the last 5 years.

We analyzed communication materials to determine how frequently 9 different messages were communicated in an attempt to influence behavior. These messages included:

- **Drain.** Drain water from water-holding compartments in recreational equipment. (Included in 60% of materials)
- **Wash or Dry.** Wash equipment with hot or high-pressure water or dry equipment. (60%)
- **Remove.** Remove AIS or other materials from recreational equipment. (58%)
- **Dispose (how to).** Acceptable methods for disposing of bait or materials removed from recreational equipment. (51%)
- **Dispose (how not to).** Unacceptable methods for disposing of bait or materials removed from recreational equipment. (50%)
- **Inspect.** Inspect recreational equipment for AIS or other materials. We identified only *explicit* statements about inspecting equipment in this category; the importance of inspecting was sometimes implicit in other messages communicated. (47%)
- **Clean.** Clean recreational equipment (in unspecified ways). Messages about specific types of cleaning (such as washing equipment or removing materials from it) were classified under other headings. (42%)
- **Report.** Report sightings of AIS. (39%)
- **Avoid vegetation.** Avoid passing through aquatic vegetation in watercraft. (13%)

In most cases, if a message was communicated, it was communicated with similar (but not identical) language and guidelines, but the messages about washing or drying equipment were not always consistent. Three primary options for cleaning equipment were offered in materials that recommended washing: hot water (76% of these materials), disinfectant solutions (52%), and high-pressure water (48%). However, the guidelines for washing with hot water and disinfectant solutions varied considerably. The specific temperature of hot water recommended for washing varied from 104 F (40 C) to 140 F (60 C). When the amount of contact time with hot water was specified, it was not always the same amount of time for the same temperature water. The instructions for washing with disinfectant solutions were similarly varied with a number of different cleaning solutions and contact times recommended in different materials. Although bleach solutions were sometimes listed as acceptable alternatives, we also encountered an explicit recommendation not to use bleach because it could damage equipment.

Recommendations for required drying times also varied. Many sources recommended drying equipment for 5 days, but the range of drying times recommended included:

- 2 to 4 days
- 2 to 7 days
- 3 days
- 5 days
- At least 5 days
- 5 to 7 days
- 5 days to 1 month

We also assessed several other characteristics of the materials:

- Arguments used to persuade recreational users to change their behavior;
- Degree of emphasis on positive outcomes of recreational users adopting desired behaviors vs. negative outcomes of them not adopting those behaviors (use of “gain framing” vs. “loss framing”);
- How AIS were defined;
- Terminology used for AIS;
- Specific AIS mentioned; and
- Links to other sources of information (such as “Stop Aquatic Hitchhikers!”).

Effectiveness and Capacity of Outreach Programs

Interviewees offered self-assessments of: (1) the effectiveness of their education and outreach efforts targeting boaters and anglers; and (2) the factors perceived to influence the capacity of their organizations to undertake and succeed at these education and outreach efforts.

With regard to effectiveness:

- Respondents believed that key audiences were generally very receptive to information about AIS and aware of and concerned about AIS. Watercraft stewards were viewed as a particularly effective form of outreach. Tournament anglers were perceived to be less receptive to AIS outreach than other anglers.
- Despite the perceived receptivity of key audiences, many respondents were uncertain as to whether or not recreational users had changed their behaviors to comply with outreach recommendations. Some of the recommended behaviors were believed to be challenging for recreationists – particularly recommendations to wash or dry equipment, which were thought to be difficult or impractical for many people.

The organizations we contacted believed that capacity for AIS outreach work in the Lake Ontario basin was enhanced by some factors, but limited by others.

- Funding was an obvious constraint on outreach capacity, and its availability influenced whether and how organizations became involved in AIS outreach. Grant funding, particularly funding from the Great Lakes Restoration Initiative, has been critically important to sustaining outreach programs.
- The capacity of programs was also influenced by the number of staff available to work on these programs and their areas of expertise. Staffing was closely related to funding.
- A number of respondents believed that ample information was available about AIS and how recreational users contributed to their spread. Sea Grant, Cooperative Extension, and universities were considered key sources of scientific expertise and resources for other organizations without such expertise.
- Many of the individuals we interviewed worked for organizations that had a recognized role in AIS education and outreach. Others worked for organizations which did not have a primary focus on outreach work. In these organizations, outreach work was influenced by the level of support from upper-level administrators in the organization.

- The availability (or lack thereof) of outreach materials affected many programs. Many organizations were not in a position to develop outreach materials on their own. Websites such as protectyourwaters.net and the New York Invasive Species Clearinghouse made materials available for others to use.
- Outreach efforts aimed at changing the behavior of recreational users were bolstered when regulations were in place requiring desired behaviors.
- One overarching factor that contributed to the capacity of outreach efforts in the Lake Ontario basin were networks of and interactions between organizations working on outreach. Such interactions were frequently mentioned during interviews. These networks served as a way for organizations to secure outreach materials, increased the number of recreational users that could be reached, increased the efficiency of outreach work, served as sources of expertise and information, and increased the consistency of outreach messages.

Social Networks and Their Influence on Messages

In a quantitative analysis of interactions between outreach programs and the messages they communicated, we found that individuals who interacted with the same set of organizations in their work on AIS were more likely to emphasize similar messages in their outreach programs. This finding suggests that coordination of messages benefits from having certain organizations used as common sources of information.

Conclusions

Our research identified a number of indicators of effective outreach to recreational users in the Lake Ontario basin about AIS. These include: engagement and cooperation of numerous organizations in outreach work, largely consistent messages, a variety of methods used to reach target audiences, receptivity among recreational users to outreach messages, and cooperation among organizations.

The capacity of outreach programs, however, is constrained by funding and staffing. Certain audiences, such as tournament anglers, are perceived to be less receptive to AIS recommendations than other recreational users and a better understanding of this audience would be valuable. Although outreach messages are generally consistent, messages about more complex and effort-intensive behaviors, such as how to wash and dry recreational equipment, can be varied. Continuing to promote certain organizations as common sources of information for developing outreach materials could help to improve this consistency.

Despite the apparent receptivity of boaters and anglers to outreach programs and messages, little concrete evidence exists to reveal the extent to which they have adopted recommended behaviors and whether particular outreach programs have encouraged these behaviors. Future research to meet these needs would be valuable, including:

- Research to assess whether anglers and/or boaters are following recommendations to prevent the spread of AIS and why or why not. It may be particularly worthwhile to

study audiences of special concern (such as tournament anglers) and behaviors of special concern (such as washing and drying equipment).

- Research to document the impacts of *particular types* of outreach programs (e.g., posting signs, watercraft stewards, distributing brochures) on user behavior. Experimental work would be most valuable at assessing impacts and could be used both to improve outreach programs and inform the designation of resources to support particular types of programs.

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We thank Charles O'Neill (Cornell Cooperative Extension) and Donald Zelazny (NYS Department of Environmental Conservation) for their advice on project design and their review of this report. We appreciate the participation of numerous individuals in the interviews and survey conducted as part of this project. Without their help and cooperation this project would not be possible.

BACKGROUND

It is well-established that the actions of recreational resource users, such as anglers and boaters, can lead to the spread of invasive species between aquatic ecosystems. States and provinces in the Great Lakes region have developed outreach efforts to discourage anglers and boaters from taking actions that can contribute to this spread. These efforts focus on preventing the movement of fish between bodies of water, proper disposal of fish carcasses and byproducts, removal of mud, plants, and animals from gear, boats, motors, and trailers, and draining and disinfecting live wells, bilges, and bait tanks.

Numerous agencies and organizations are involved in this outreach work. The degree to which these efforts succeed depends in part on the agencies and organizations that become involved, their capabilities, and the compatibility of their activities. What messages are different organizations communicating about invasive species prevention? Are they communicating similar messages and using similar language? Are they communicating inconsistent messages? Are the organizations that are best able to reach and influence recreational users involved in communicating these messages? Are sufficient resources available to take the actions deemed necessary?

We studied how government and nongovernmental organizations operating at the federal, state/provincial, and community level attempt to encourage behavior in anglers and boaters that will reduce the spread of invasive species. In particular, we:

- Identified organizations engaged in aquatic invasive species (AIS) outreach in the Lake Ontario basin;
- Characterized the outreach efforts of these organizations, including the groups they target, the messages they communicate, the outreach strategies they utilize, and the perceived effectiveness of their work;
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- A study of how bait dealers in Indiana, Michigan, New York, Ohio, Ontario, and Wisconsin have responded to regulations and recommendations intended to reduce the spread of AIS and fish pathogens (Connelly et al. 2014c).
- A study of how boating facilities, bait dealers, and angler and boating organizations have contributed to AIS outreach efforts in the Lake Ontario basin (Connelly et al. 2014a).

Conceptual Foundation

We designed our data collection and analysis to explore characteristics of AIS outreach to recreational users that the literature on risk, health, and persuasive communication suggests could contribute to the effectiveness of that outreach. Some of these characteristics were concerned with the descriptions of desired behaviors that are communicated:

- Past work has concluded that desired behaviors should be described to target audiences in language that is clear, simple, and concise (Conway and Opsommer 2007, Marion and Reid 2007). Complex behaviors may be more difficult for audiences to understand and adopt.
- Closely related to this point is the recommendation that messages be consistent (Marion and Reid 2007). Inconsistent messages can undermine the clarity of desired behaviors. Questions about consistency become particularly important in contexts in which multiple organizations may be communicating information on the same topic, such as in AIS outreach efforts.

In addition to communicating desired behaviors to recreational users, AIS outreach programs often communicate arguments for adopting those behaviors. The literature identifies elements of such arguments that influence their persuasiveness:

- Many persuasive arguments rely on “fear appeals,” which are intended to raise concerns that can be alleviated with behavior changes (Stiff 1994, Witte and Allen 2000). To be effective, fear appeals may need to include messages about both the situation of concern and the effectiveness of behaviors for addressing that concern. In AIS outreach, therefore, outreach programs may need to communicate about both the threats posed by AIS and how recreational users’ behavior can help to reduce that threat.
- The literature has explored differences in how audiences respond to “loss framing” and “gain framing” in persuasive arguments (Keller and Lehman 2008). Loss framing describes negative outcomes if a person does not adopt a behavior (e.g., how dumping your bait bucket in a different lake can spread AIS). Gain framing describes positive outcomes if a person does adopt a behavior (e.g., how cleaning your boat can help prevent the spread of AIS). Although the difference between loss framing and gain framing has been identified as important, the literature is inconclusive with regard to which approach is preferable.

In addition to the outreach messages themselves, the strategies organizations use to reach recreational users contribute to the effectiveness of their programs. Nguyen et al. (2012, p. 248) found that anglers could be classified into different types with different preferences for obtaining information, including “in-person communication, regulation handbooks, media, and the Internet.” They concluded that because anglers had different communication preferences a mixture of communication strategies was required for effective outreach to recreational users.

We were also interested in how organizations developed and maintained the capacity of their outreach programs to reach recreational users. Press (1998, p. 29) defined capacity as an “ability to define and respond to problems” – in this case, an ability to respond to the problem of invasive

species being spread by recreational resource users. Lauber et al. (2011) developed a model of the elements and processes that influence the capacity of conservation efforts in multi-organizational contexts. The model specifies a number of factors that affect capacity for conservation action.

- At a basic level, conservation actions (such as outreach to recreational users) require resources, such as funding and labor.
- The selection of actions needed to achieve conservation outcomes depends on information, including both information from scientific research or theory and experiential knowledge.
- The ability to secure resources and information to carry out actions depends on securing support or approval from those with authority or influence, including organizational leaders, government officials, staff of nongovernmental organizations, land managers, or resource users. Securing support for an initiative allows for access to resources and contributes to authorization of actions.
- In a multi-organizational context, actions are also enabled by coordination of activities. Coordination involves joint decision making among collaborators about how they can most efficiently use their combined funding, labor, and information resources to achieve common objectives.
- Collaborative initiatives also depend on relationships and dialogue among organizations working toward interrelated ends. Relationships and dialogue contribute to agreements about the outcomes organizations hope to accomplish and what actions need to be taken to accomplish these outcomes. Agreement provides a foundation for legitimizing activities and further enables coordination of activities.

Because of the fundamental importance of relationships and dialogue to capacity, we incorporated research tools that could document the patterns of connections that exist between organizations. One suite of techniques that can be used to document such connections is known as social network analysis (described below). These techniques are effective means of characterizing and quantifying patterns of relationships between networks of interacting organizations or individuals. Past work has explored how connections within social networks can lead to the adoption of similar practices or the development of similar attitudes within a group (Burt 1987, Rice and Aydin 1991, Strang and Soule 1998). In a context such as AIS outreach in which communication of consistent messages may be important, we hypothesized that connections within a network could contribute to this consistency.

METHODS

Our research consisted of three components:

- **Telephone interviews.** We conducted a series of semi-structured, individual interviews with representatives of organizations working on AIS outreach in the Lake Ontario basin. The purpose of the interviews was to collect information on the organizations' AIS outreach programs and on factors that influenced their implementation of those programs.
- **Document analysis.** We gathered and analyzed the content of educational outreach materials related to AIS targeting recreational users. We identified messages

communicated to recreational users that were intended to encourage them to adopt behaviors to reduce the spread of invasive species. These materials were gathered from those organizations targeted during the telephone interviews.

- **Web-based survey.** We conducted a survey of the same individuals who we interviewed during the telephone interviews. The survey was designed to: (a) collect standardized data on each organization's AIS outreach program; and (b) gather information on the interactions between organizations working on these outreach efforts.

All research procedures were approved by Cornell University's Institutional Review Board for Human Participants (protocol ID# 1004001374).

Telephone Interviews

We conducted telephone interviews with representatives of organizations in the U.S. and Canadian portions of the Lake Ontario basin with an explicit focus on preventing the spread of AIS – those for which AIS prevention is a primary purpose. In particular, we interviewed representatives of organizations that try to influence the behaviors of boaters and anglers in their efforts to reduce the spread of AIS. The interviews provided in-depth information about outreach programs and helped inform the development of the web-based survey, which was conducted later in the project.

We attempted to identify and interview representatives of all organizations conducting AIS outreach to boaters and anglers in the Lake Ontario basin. An initial set of interviewees was identified based on the recommendations of project collaborators who were experienced with AIS prevention efforts in the study area. Additional interview respondents were identified through “snowball sampling” (Seidman 1998) (i.e., asking our initial interview respondents for recommendations of other organizations and individuals, contacting those organizations or individuals and asking them to participate, then asking them for additional suggestions of individuals to interview, and continuing this process until no new additional contacts were identified).

A total of 35 interviews were conducted. We recruited interview respondents by email or telephone and conducted interviews by telephone. The specific interview questions (Appendix A) were designed to:

- Identify the explicit or implicit goals and objectives of these organizations related to AIS prevention.
- Document actions by these organizations to manage invasive species using education and outreach and categorize:
 - The behaviors these actions attempt to encourage or discourage
 - The messages used to influence these behaviors.
- Document the characteristics of the organizations that are salient to invasive species prevention efforts including:
 - Funding, equipment, facilities, information, labor, or other types of resources devoted to invasive species prevention efforts.

- Organizational missions that relate to invasive species prevention, legal authority to formulate regulations related to invasive species prevention, or connections and/or credibility with recreational users.
- Priority placed on invasive species prevention relative to other activities.

Interview questions were open-ended (questions that respondents answer in their own words rather than choosing from among pre-defined answer choices). The interviews were semi-structured (interviewers had an initial list of questions but asked additional questions on related topics to follow up on the responses of individual respondents).

All interviews were recorded and transcribed, except for two interviews in which respondents were found to devote no effort to AIS outreach. Transcripts were analyzed using a process known as “coding” (Miles and Huberman 1994), an approach that is often used in qualitative data analysis (analysis of data that is in the form of words rather than numbers). During coding, interview transcripts are broken into segments (usually one to several sentences) and assigned to descriptive categories related to the topic of the response. Codes were used to characterize the variety of:

- goals and objectives of each organization related to invasive species;
- types of behavior change sought by each organization;
- particular messages communicated to influence these behaviors;
- indicators of the success of these efforts; and
- factors influencing the capacity of the organizations to carry out these efforts successfully.

The coding process was carried out using ATLAS.ti (Scientific Software Development 2002). ATLAS.ti is qualitative data analysis software. The relevant segments of the document are selected and assigned codes (as described above). The software simplifies the process of retrieving and reviewing coded segments.

Document Analysis

We gathered educational outreach materials targeting boaters and anglers with messages related to AIS and conducted a content analysis of those materials. During the telephone interviews, we asked interview respondents to identify and share outreach materials they use with boaters and anglers in an effort to discourage behaviors that can lead to the spread of invasive species.

Materials were coded (described above). During coding, the materials were broken into segments with each segment representing a distinct message intended to discourage behaviors that could lead to the spread of invasive species. We began with an initial list of codes based on the literature and our experience with AIS, but that list was revised and expanded to reflect the content of the outreach materials. All of the excerpts assigned to a particular code were identified and reviewed periodically to ensure that codes were being applied consistently.

After coding was complete, we tabulated electronically how frequently different types of messages appeared in the materials. We assessed the consistency of outreach messages by determining:

- the number and percentage of organizations that communicate each message through their outreach materials; and
- the existence of any incompatible messages (e.g., communication of different messages about what anglers should do with leftover bait).

Web-based Survey

We conducted a standardized, web-based survey of the individuals interviewed earlier in the project to collect quantified data about the characteristics of their AIS outreach programs targeting boaters and anglers and assess how frequently they interacted with other organizations engaged in similar types of outreach (Appendix B). During the telephone interviews, we notified respondents that this survey would be taking place in the future and asked if they were willing to participate in it. All individuals agreed to participate.

Respondents were asked a series of standardized questions about:

- Effort devoted to aquatic and terrestrial invasive species;
- Program objectives related to AIS;
- Effort devoted to education and outreach efforts targeting recreational users;
- Messages communicated in education and outreach efforts;
- Education and outreach activities; and
- Social network questions.

The “social network” questions were included to determine how frequently each organization interacted with the other organizations targeted by the survey. Respondents were asked “During the past five years, how frequently have you interacted with individuals in each of the following organizations (including other individuals in your own organization) *in your work on aquatic invasive species?*” Answer choices included never, rarely (no more than once a year), sometimes (several times a year), frequently (at least once a month), very frequently (at least once a week).

Individuals were e-mailed at the initiation of the survey and provided with a link to a web-based questionnaire. Individuals who did not respond to the first request received up to three additional requests to complete the questionnaire by e-mail. The web-based survey instrument was programmed and administered using Qualtrics (Qualtrics Labs Inc. 2005), which provides a means of soliciting participation in a survey via email and recording responses. Qualtrics assigns each individual a unique web link to prevent individuals outside our study population from participating in the survey and prevent access to survey data by anyone other than the research team.

The social network data were analyzed using UCINET 6, a software package specifically designed for conducting social network analyses (Borgatti et al. 2002). Analysis of social

network data focuses on the patterns of relationships between “actors” (in this case, organizations and individuals working on AIS-related outreach).

The data collected through these questions can be portrayed in a matrix in which the rows are survey respondents, the columns are organizations, and the cells contain respondents’ answers regarding how frequently they interacted with each organization. We converted respondents’ answers into an approximate number of interactions per year (“never” =0; “no more than once a year”=1; “several times a year”=4; “at least once a month”=12; and “at least once a week”=52).

We converted this original data matrix to an “affiliation matrix” (Wasserman and Faust 1994) in which both rows and columns represented survey respondents. The numerical value in each cell of the matrix represented the tie (or strength of the relationship) between two respondents based on the number of organizations they interacted with in common and the frequencies of those interactions. (The value of each cell, ij , in the affiliation matrix is calculated by taking the products of the rows for respondent i and respondent j in the original matrix using matrix multiplication techniques.) Conceptually, a relatively high number in the affiliation matrix indicates that two respondents tended to interact with the same set of organizations in their work on AIS and a relatively low number indicates that two respondents tended to interact with different sets of organizations in their work on AIS. The affiliation matrix, therefore, reflects the degree to which individuals are subject to the same social influences in their AIS outreach work.

We hypothesized that respondents with stronger ties would communicate more similar messages in their outreach to boaters and anglers. We tested this hypothesis by estimating the predicted emphasis each respondent would place on each of 16 possible outreach messages. The predicted emphasis for each message for each respondent was the weighted average of the emphasis placed on that message by all other individuals in the network (where the weights used were the strength of the relationship between each pair of individuals as represented in the affiliation matrix). We calculated the degree to which the predicted emphasis on each message was correlated with the actual emphasis on each message.

RESULTS

The results are organized into four parts:

- An overview of outreach programs and messages (based on the web-based survey);
- A detailed analysis of outreach messages (based on the content analysis of outreach materials);
- An assessment of the effectiveness and capacity of outreach programs (based on the interviews); and
- An analysis of social networks and their influence on outreach.

Part 1: Overview of Outreach Programs

Organizational Goals Related to AIS

Through our web-based survey, we attempted to characterize the work of individuals focused on outreach to boaters and anglers about how to prevent the spread of AIS in the Lake Ontario

basin. Consequently, almost all of our respondents worked on AIS to at least some degree. They represented a ranged of types of organizations including:

- nongovernmental organizations (8 individuals);
- extension (5 individuals);
- local government (4 individuals);
- state/provincial fish and wildlife agencies (4 individuals);
- Sea Grant (3 individuals);
- state parks agencies (3 individuals);
- federal government (2 individuals);
- state transportation agencies (2 individuals);
- soil and water conservation districts (2 individuals);
- colleges/universities (1 individual); and
- environmental consulting (1 individual).

Seventy-one percent said they spent “a moderate amount” or “a great deal of” time on work related to AIS, and 3% said they devoted “no time” to AIS. Many also worked on terrestrial invasive species, with 52% spending a moderate amount or great deal of time on terrestrial invasive species and only 12% devoting no time to terrestrial invasive species.

The AIS programs of our respondents encompassed a range of objectives (Table 1). Three of the four most common objectives were directly related to outreach:

- Raising awareness about AIS;
- Changing behaviors that lead to the spread of AIS; and
- Providing people with the information they want or need about AIS.

The fourth most common objective (preventing the introduction and spread of AIS) was potentially related to outreach.

Contributions to Education and Outreach Efforts Related to AIS

The 35 respondents to our survey had outreach programs that attempted to influence the behavior of different audiences to prevent the spread of AIS:

- 66% had programs targeting boaters.
- 63% had programs targeting anglers.
- 71% had programs targeting other groups that may include people who boat or fish.
- 77% (27 individuals) had programs targeting at least one of these three groups.

Our remaining results pertain only to those 27 respondents who tried to influence the behaviors of boaters, anglers, or other groups that may include people who boat or fish.

More than 70% of this group used the New York Invasive Species Clearinghouse (NYIS.INFO) as a source of information in their work on AIS at least several times a year (Table 2). More than 30% used it at least once a month.

Table 1. Emphasis on program objectives related to AIS.

AIS objectives	No emphasis	Only a little emphasis	A moderate amount of emphasis	A great deal of emphasis
Raise awareness about AIS	3.0	15.2	21.2	60.6
Prevent the introduction and spread of AIS	3.0	12.1	30.3	54.5
Change behaviors that lead to the spread of AIS	3.0	9.1	39.4	48.5
Provide people with the information they want or need about AIS	3.0	18.2	33.3	45.5
Foster collaboration between organizations doing work on AIS	6.1	30.3	24.2	39.4
Build public support for management actions related to AIS	9.1	33.3	24.2	33.3
Control or eliminate existing populations of AIS	18.2	18.2	33.3	30.3
Reduce the negative impacts of AIS	15.2	42.4	18.2	24.2
Increase the availability of research-based information about AIS	15.2	30.3	33.3	21.2
Detect new populations of AIS	21.2	33.3	27.3	18.2

Table 2. Percentage of respondents using the New York Invasive Species Clearinghouse as a source of information.

Frequency of Use	Percent of Respondents
Weekly	9.4
At least once a month	21.9
Several times a year	40.6
No more than once a year	15.6
Never	12.5

Messages Communicated to Boaters and Anglers

We asked respondents how much of an emphasis they placed on each of 10 potential messages about AIS in their education and outreach efforts targeting boaters, anglers, or other groups that may include many people who boat for fish. At least three-quarters of the respondents placed a moderate or great deal of emphasis on 6 of the 10 messages (Table 3). The 3 messages that were communicated less consistently, receiving a moderate or great deal of emphasis by fewer than half of respondents, were:

- Do not pass through aquatic plants in your boat;
- Use only locally bought bait; and
- Run your boat engine after you remove it from the water.

We also asked how much emphasis was placed on an additional 6 messages pertaining specifically to what should be done with unused live baitfish (Table 4). These messages were less consistently communicated, in part because fewer outreach programs were concerned with baitfish. Three messages received at least some emphasis by more than half of respondents:

- Unused live baitfish should not be thrown into a body of water other than the water where you caught them;
- Unused live baitfish may be disposed of in the trash; and
- Unused live baitfish may be disposed of on dry land.

These messages emphasized safe disposal of baitfish as well as what *not* to do with baitfish. The remaining 3 messages received *no* emphasis by approximately two-thirds of respondents. These messages were concerned with the release or reuse of baitfish.

- Unused live baitfish may be thrown back into the water where you caught them;
- Unused live baitfish may be given to other anglers to use; and
- Unused live baitfish may be taken home.

Activities Targeting Boaters and Anglers

Respondents relied on a variety of activities to target boaters and anglers in their outreach programs (Table 5). Six activities were used by at least half of respondents:

- Distributing print materials;
- Making presentations to specific groups or the general public;
- Maintaining web sites;
- Conducting workshops or training sessions;
- Staffing booths at community events or festivals; and
- Communicating through the mass media (newspapers, radio, television, etc.).

Table 3. Emphasis on messages communicated to boaters and anglers.

Messages	No emphasis	Only a little emphasis	A moderate amount of emphasis	A great deal of emphasis
Drain all water holding compartments including live wells, bait wells and bilge areas	3.8	3.8	23.1	69.2
Inspect fishing and boating equipment for attached aquatic plants and animals	3.7	7.4	22.2	66.7
Remove any visible mud, plants, fish or animals before transporting fishing or boating equipment	3.7	7.4	25.9	63.0
Report sightings of aquatic invasive species	0.0	14.8	25.9	59.3
Dry boats, trailers and all fishing or boating equipment before use in another water body	3.7	18.5	18.5	59.3
Learn to identify aquatic invasive species	0.0	22.2	33.3	44.4
Disinfect or rinse with hot water anything that came into contact with water before reuse	22.2	22.2	22.2	33.3
Do not pass through aquatic plants in your boat	22.2	33.3	33.3	11.1
Use only locally bought bait	25.9	33.3	29.6	11.1
Run your boat engine after you remove it from the water	51.9	14.8	22.2	11.1

Table 4. Emphasis on messages related to baitfish disposal.

Messages	No emphasis	Only a little emphasis	A moderate amount of emphasis	A great deal of emphasis
Unused live baitfish should not be thrown into a body of water other than the water where you caught them	46.2	11.5	19.2	23.1
Unused live baitfish may be disposed of in the trash	48.1	11.1	18.5	22.2
Unused live baitfish may be disposed of on dry land	40.7	18.5	22.2	18.5
Unused live baitfish may be thrown back into the water where you caught them	65.4	7.7	19.2	7.7
Unused live baitfish may be given to other anglers to use	66.7	11.1	14.8	7.4
Unused live baitfish may be taken home	66.7	11.1	18.5	3.7

Table 5. Activities used by respondents to encourage boaters and anglers to adopt behaviors that will reduce the spread of AIS.

Activity	Percent of Respondents
Distributing print materials	74.3
Making presentations to specific groups or the general public	68.6
Maintaining web sites	62.9
Conducting workshops or training sessions	60.0
Staffing booths at community events or festivals	57.1
Communicating through the mass media (newspapers, radio, television, etc.)	54.3
Posting signs at boat launch sites or fishing access sites	48.6
Maintaining Facebook pages	40.0
Having “stewards” available to speak to watercraft users or anglers about best practices at marinas or access points	37.1
Making invasive species disposal stations available at boat launch sites or fishing access sites	31.4
Maintaining displays or exhibits demonstrating how to clean recreational equipment	28.6
Communicating through Twitter	25.7
Staffing booths at boat shows	22.9
Posting quick response (QR) codes directing individuals to information on the web	20.0
Maintaining hotlines to provide information about aquatic invasive species	17.1
Distributing refrigerator magnets	11.4
Maintaining billboards	8.6
Making boat washing stations available for boaters to use	8.6
Developing smart phone apps	5.7

Part 2: Analysis of Outreach Messages

The individuals we interviewed provided us with a variety of materials that they used in their outreach to boaters and anglers. We identified and analyzed 72 discrete materials used in the Lake Ontario basin that were designed (at least in part) to influence the behavior of boaters and/or anglers to help prevent the spread of AIS. These materials were sponsored by a variety of organizations and programs, and many were jointly sponsored by more than one organization (Table 6). Many organizations shared materials, and, therefore, the sponsor of the material was not necessarily the organization using the material in communication campaigns.

Only 36% of the materials listed the year in which they were published or updated. Of these materials, 89% were developed or updated within the last 10 years, and 63% were developed or updated within the last 5 years.

Our analysis included 9 different types of communication materials (Table 7). Eighty-five percent of these materials were one of four types: single-page print materials, signs, watch cards (card-sized print materials focused on AIS identification), and websites.

Messages

We analyzed communication materials to determine how frequently 9 different messages were communicated in an attempt to influence behavior. These messages included:

- **Inspect.** Inspect recreational equipment for AIS or other materials. We identified only *explicit* statements about inspecting equipment in this category; the importance of inspecting was sometimes implicit in other messages communicated. (47%)
- **Clean.** Clean recreational equipment (in unspecified ways). Messages about specific types of cleaning (such as washing equipment or removing materials from it) were classified under other headings. (42% of materials)
- **Remove.** Remove AIS or other materials from recreational equipment. (58% of materials)
- **Drain.** Drain water from water-holding compartments in recreational equipment. (60% of materials)
- **Wash or Dry.** Wash equipment with hot or high-pressure water or dry equipment. (60% of materials)
- **Dispose (how to).** Acceptable methods for disposing of bait or materials removed from recreational equipment. (51% of materials)
- **Dispose (how not to).** Unacceptable methods for disposing of bait or materials removed from recreational equipment. (50% of materials)
- **Avoid vegetation.** Avoid passing through aquatic vegetation in watercraft. (13% of materials)
- **Report.** Report sightings of AIS. (39% of materials)

Table 6. Organizations and programs sponsoring communication materials analyzed.

Source	Number of Materials
Ontario Federation of Anglers and Hunters	20
New York State Department of Environmental Conservation	15
Province of Ontario	15
Minnesota Sea Grant	8
Ontario's Invading Species Awareness Program	8
New York Sea Grant	7
New York State Office of Parks, Recreation and Historic Preservation	5
Cornell Cooperative Extension (Onondaga County)	4
Finger Lakes Institute	4
Cayuga County Department of Planning and Economic Development	3
Cornell Cooperative Extension	3
Cornell Cooperative Extension (Cayuga County)	2
City of Syracuse	2
Illinois-Indiana Sea Grant	2
New York Invasive Species Clearinghouse	2
Adirondack North Country Association	1
Adirondack Park Invasive Plant Program	1
ANS Task Force	1
Canada	1
Cayuga County Water Quality Management Agency	1
Cayuga Lake Watershed Network	1
Cornell Cooperative Extension (Tompkins County)	1
Illinois Natural History Survey	1
Minnesota Department of Natural Resources	1
New York State Department of Transportation	1
Ontario Ministry of Natural Resources	1
Oswego County Soil and Water Conservation District	1
Scenic Byways	1
St. Lawrence-Eastern Lake Ontario Partnership for Regional Invasive Species Management	1
Stophydrilla.org	1
The Central and Western NY Chapter of The Nature Conservancy	1
The Hydrilla Task Force of the Cayuga Lake Watershed	1
U.S. Fish and Wildlife Service	1

Table 7. Types of materials analyzed.

Type of Material	Number of Materials of Each Type
Print material (single page)	24
Sign	13
Watch cards	13
Website	11
Sticker	5
Print material (multiple pages)	3
Keychain	1
Ruler	1
Vehicle (messages on side of vehicle)	1

The first six of these messages were often associated with each other. When one of these messages was communicated, other messages in this set were often also communicated (Table 8). The other three messages were not as consistently associated with each other or any of the other messages.

Inspect. Nearly half (47%) of the materials included an explicit message to “inspect” recreational equipment for AIS or other materials. Of these 47%, nearly three-quarters explicitly mentioned boats or trailers (Table 9).

The specific language used to communicate these messages varied somewhat from one material to another, although the messages were largely consistent. The materials with the least amount of text, such as signs and key chains, often included very simple messages:

Inspect. Clean. Drain. (ON-6a,b)

Most materials, however, provided fuller descriptions of what equipment should be inspected for and what types of equipment should be inspected. Some materials simply advised checking for plants:

Inspect boats, equipment, and trailers for any plant fragments after each use. (CCE-2)

Others referred to plants and “debris.”

Check for and remove any visible plants or debris. (NY-1)

The most expansive descriptions referred to a variety of types of material or organisms:

Check and remove any visible mud, plants, fish or organisms. (CCE-ON-1)

Only rarely did materials specifically instruct recreational users to inspect for “invasive species”:

Check your boating and fishing equipment for invasive species. (NY-17)

Some materials that focused primarily on a specific type of AIS emphasized inspecting for that AIS in their messages. For example, the following message focuses heavily on zebra mussels:

Thoroughly inspect the boat, motor, trailer and attached equipment for mud, plants and mussels. Remove all materials found. In addition to looking – inspect by running your hand along the entire surface of the equipment. Juvenile zebra mussels will feel like sandpaper. (NY-18)

With regard to what type of equipment needed to be inspected, some materials described these types of equipment in fairly general terms, although the types of equipment mentioned varied from one material to another, sometimes depending on the target audience:

Inspect your boat, trailer, and equipment. (MN-1)

Table 8. Percentage of materials communicating messages (in rows) that also communicated related messages (in columns).

Message Communicated	Percentage of Materials Communicating Related Messages					
	Inspect	Clean	Remove	Drain	Wash or Dry	Dispose (how to)
Inspect	-	60%	69%	61%	67%	62%
Clean	53%	-	50%	51%	58%	41%
Remove	85%	70%	-	79%	79%	73%
Drain	77%	73%	81%	-	77%	65%
Wash or Dry	85%	83%	81%	77%	-	68%
Dispose (how to)	68%	50%	64%	56%	58%	-

Table 9. Percentage of materials including messages to “inspect” equipment that explicitly mentioned specific types of equipment.

Equipment Type	Percentage of Materials
Boats	71%
Trailers	71%
Fishing gear	18%
Clothing	15%
Pets	9%
Specific parts of boats or trailers	
Rollers/bunks	29%
Live or bait wells	26%
Transom well, transom, or bilge area	26%
Axle	26%
Lower unit/propellers	24%
Motor	18%
Anchor and/or anchor rope	18%
Hull	15%
Hitch	12%

Before leaving any body of water, it is important to examine all your equipment, boats, trailers, clothing, boots, buckets, etc.... (ANS-1)

Water recreationists must take great care to inspect, clean, and dry all equipment, especially waders and boots when leaving an infested stream or river. (NYIS-1A)

Other materials offered much more detailed, but still varied, descriptions of what needed to be inspected:

Hitch, live well, transom well, rollers, axle, lower unit/propeller. (CCE-ON-1)

Dock lines, storage compartments, anchor, live wells, bilge, prop, motor intakes, gimble area, rollers/bunks, axle, hull, trailer, through-hull fittings. (FLI-1)

Inspect any equipment used during the boating trip, including nets, oars, water skis and ropes, personal floatation devices, floatation cushions and waterfowl decoys. (NY-18)

Be sure to carefully examine these common invasive species attachment points – fishing lures, motor props, transducer, rollers, axles, license plate, lights, trailer bunks. Don't forget to also inspect all gear used during your fishing or boating trip. (NY-17)

Clean. Forty-three percent of the materials we analyzed made general statements about cleaning equipment or other items. Of these 43%, nearly half mentioned boats specifically, with trailers, pets, clothing, and fishing gear mentioned less frequently (Table 10).

The messages about cleaning recreational equipment were often fairly simple. They provided general guidelines about the importance of cleaning, but the more detailed discussions of *how* to clean were communicated as part of other messages (remove, spray/rinse or dry, etc.).

Sometimes these messages were communicated as part of very brief reminders about recommended practices:

Clean. Drain. Dry. (CCE-4)

Table 10. Percentage of materials including messages to “clean” equipment or other items that explicitly mentioned specific items.

Equipment Type	Percentage of Materials
Boats	48%
Trailers	29%
Clothing	19%
Pets	19%
Fishing gear	10%

Generally, however, the messages were slightly longer. The most frequent statement encountered was:

Clean all recreational equipment. (OF-13)

Other messages emphasized cleaning things they came into contact with water:

Clean and dry anything that comes into contact with water (boats, trailers, waders, wading boots, equipment, dogs, etc.). (NY-3)

Clean all parts and equipment that came in contact with the water. (ANS-1)

The particular type of equipment emphasized varied somewhat from material to material, often depending on the intended target audience:

Inspect, clean and dry all equipment before traveling to a new waterbody including boats and trailers. (SL-1)

Clean your boat and fishing equipment. (NYParks-4)

Inspect and clean fishing tackle. (SG-10)

Remove. Over half (58%) of the materials communicated messages about removing foreign materials from recreational equipment. Of this set of materials, almost all (98%) specifically mentioned removing aquatic plants. More than half recommended removing mud (62%) and aquatic animals (52%). About one-quarter (26%) stated that fish should be removed.

Like the messages discussed above, not every message about removing foreign materials from recreational equipment explicitly mentioned a specific type of equipment. Of those that did, however, over half mentioned boats and trailers (Table 11).

Table 11. Percentage of materials including messages to “remove” foreign materials from equipment that explicitly mentioned specific types of equipment.

Equipment Type	Percentage of Materials
Boats	57%
Trailers	55%
Fishing gear	17%
Clothing	12%
Specific parts of boats or trailers	
Motor	24%
Anchor and/or anchor rope	14%

Although the language used to communicate these messages varied somewhat from one material to another, often it was fairly similar:

Remove visible aquatic plants, animals, and mud before leaving the water access. (MN-1)

Remove any visible mud, plants, fish or animals before transporting equipment. (CCE-3)

Check and remove any visible mud, plants, fish or organisms from boats, trailers, equipment, clothing, dogs, etc. (CCE-ON-1)

Scrape off and trash any suspected mussels. Remove all hitchhiking water weeds. (NYSG-1)

Drain. Forty-three percent of the materials we analyzed communicated messages about draining or removing water from recreational equipment after using it. Approximately two-thirds of these materials stipulated that live wells and bilges should be drained with other types of equipment being explicitly mentioned less than half the time (Table 12).

The wording of the messages was fairly similar. Most materials used the word “drain” although a number referred to “eliminating water.” For example:

Drain lake or river water from bilge, livewell and motor before leaving access. (SG-8)

Clean and eliminate water from equipment. (CC-1)

Table 12. Percentage of materials including messages to “drain” equipment that explicitly mentioned specific types of equipment.

Equipment Type	Percentage of Materials
Live wells	67%
Bilges	65%
Boats	40%
Motors	26%
Bait containers	26%
Ballast tanks	14%

Some materials simply instructed recreational users to drain equipment, while others specified that equipment should be drained before leaving the access site:

Drain water from the motor, live well, bilge and transom wells while on land immediately before leaving the waterbody. (OF-14)

Messages also differed in level of detail:

Drain your boat. (NY-9)

Drain all water holding compartments including live wells, bait wells and bilge areas. Drain your boat before you leave the access site! Be sure to drain boat ballast tanks if your waterski or wakeboard has them. Drain your livewell if you have one. (NY-17)

While on land, but before leaving a body of water:

- *Drain water out of every conceivable item that can hold water:*
- *Follow factory guidelines for eliminating water from engines. All engines hold water, but jet drives on personal watercraft and other boats can hold extra water.*
- *Remove the drain plug from boats and put boat on an incline so that all the water drains out.*
- *Drain live-wells, bilge and transom wells*
- *Empty water out of kayaks, canoes, rafts, etc. (ANS-1)*

Wash or Dry. Instructions to “wash or dry” recreational equipment were some of the more complicated messages communicated. Users were typically told to *either wash or dry* their equipment. Sixty percent of the materials included messages about washing or drying. Of this 60%, 93% had messages about drying equipment, 67% had messages about washing equipment, and 63% had messages that referred both to drying and washing.

The specific types of equipment mentioned in materials that should be washed or dried varied (Table 13). Boats were explicitly mentioned in 60% of the materials that had messages about washing or drying. Trailers were mentioned in about one-third of the materials. Clothing, bait/live wells, pets, and bilges were mentioned less frequently.

Table 13. Percentage of materials including messages to “wash or dry” equipment that explicitly mentioned specific types of equipment.

Equipment Type	Percentage of Materials
Boats	60%
Trailers	35%
Clothing	21%
Bait/live wells	21%
Pets	14%
Bilges	14%

The materials that recommended washing offered three primary options for cleaning equipment: hot water (76% of materials), disinfectant solutions (52% of materials), and high-pressure water (48% of materials). However, the instructions regarding both hot water and disinfectant solutions varied considerably. The specific temperature of hot water recommended for washing

varied from 104 F (40 C) to 140 F (60 C) (Table 14). In some materials the amount of contact time of the hot water with the equipment was specified, and in other cases it was not. When the amount of contact time was specified, it was not always the same amount of time, although this difference was because different recommendations were made for different types of AIS.

Table 14. Temperatures and contact times recommended for washing recreational equipment with hot water.

Temperature	Contact Time
104 F (40 C)	unspecified
105 F (41C)	unspecified
110 F (43 C)	20 minutes
122 F (50 C)	unspecified
140 F (60 C)	unspecified
140 F (60 C)	1 minute
140 F (60 C)	10 minutes

The instructions for washing with disinfectant solutions were similarly varied (Table 15). Some of the differences between recommended cleaning solutions and times were because different solutions were recommended for different types of AIS, although this reasoning was not always clarified. In most cases, different solutions were presented as acceptable alternative approaches. However, at least one incompatibility between recommendations existed. Although bleach solutions were sometimes listed as acceptable alternatives, we also encountered an explicit recommendation not to use bleach because it could damage equipment.

Recommendations for required drying times also varied. Many sources recommended drying equipment for 5 days. Some sources noted that drying times would vary depending on the conditions, and therefore some sources recommended a range of possible drying times needed. Considering the entire set of materials, the recommended drying times include:

- 2 to 4 days
- 2 to 7 days
- 3 days
- 5 days
- At least 5 days
- 5 to 7 days
- 5 days to 1 month

Dispose (How to). Fifty-one percent of the materials we analyzed communicated messages about how to dispose of materials that were potentially contaminated with AIS. Of those, 59% communicated about how to dispose of unwanted bait, and 57% communicated about how to dispose of materials other than bait (usually materials removed from recreational equipment).

Table 15. Cleaning solution and contact times recommended for washing recreational equipment with disinfectant solutions.

Cleaning Solution	Contact Time
Bleach solution	
2% solution	1 minute
2% solution	10 minutes
10% solution	1 minute
Potassium chloride (200 ppm)	10 minutes
Cleaners containing quarternary ammonium compounds, such as alkyl dimethyl benzyl ammonium chloride (Parvasol, Kennelsol, Formula 409, Fantastic, etc.)	10 minutes
Vinegar (100% solution)	20 minutes
Salt	
1% solution	24 hours
5% solution	30 minutes
Non-eco-friendly detergent (5% solution) in 115 F (46 C) water	30 minutes

The instructions for what to do with these materials included:

- Dispose in the trash (with some materials specifying that the trash should be above the waterline);
- Dispose of on dry land; and
- Dispose of in an invasive species disposal station.

Examples of messages focused on bait disposal include:

Empty your bait bucket on land, or freeze or salt the bait to use later. (OF-1)

If you find yourself with a bucket of live bait at the end of the day, either dispose of your unwanted live bait on land or give your bait to another angler for his or her use. (ANS-1)

Examples of messages focused on disposal of other material include:

Remove and dispose of all plant matter, dirt, mud, etc. in trash cans or above the waterline on dry land where it won't get washed back into the lake. (CCE-2)

Discard items in an upland area or in one of the invasive species disposal stations that have been installed at many boat launch sites for your convenience. (NY-17)

Stock your boat with plastic trash bags. If you bring ANY vegetation up from the Inlet or Lake on the anchor, lines, fishing gear, prop, paddles etc., DO NOT RETURN it to the water. Place it in a trash bag and dispose of it back on shore at a plant disposal station or trash receptacle. (CCET-1)

Dispose (How not to). Fifty-three percent of the materials we analyzed communicated messages about unacceptable methods for disposing of unwanted bait and other materials. The vast majority of these messages focused specifically on unwanted bait:

Never release live fish or baitfish from one body of water into another. (OF-1ab)

Some also referred to other types of organisms, too:

Never release plants, fish or animals into a body of water unless they came out of that body of water. (CCE-ON-4)

Never release bait, aquarium plants or animals, or pond specimens into the water. (CCE-ON-3)

Of the materials that contained this type of message, 58% specifically referred to the source of the bait as an important consideration when making decisions about how to dispose of it.

Do not release any fish or dump baitfish into a body of water that they did not come from. (NY-16)

Never release plants, fish or animals into a body of water unless they came out of that body of water. (NY-8)

Other materials did not mention the source of bait:

Don't dump your baitfish. (ON-7)

Please do not dump bait, fish, other animals or plants into the water! (NYParks-1)

Avoid Vegetation. Only 13% of the materials included messages recommending that recreational users avoid passing through aquatic vegetation in watercraft.

Be aware of and, if possible, avoid passing through dense beds of aquatic vegetation. (NYIS-1B)

Avoid boating through matted aquatic plants that could collect on your boat or motor. (NY-18)

Some of these messages were targeting an area with a hydrilla infestation in which avoiding areas with aquatic vegetation could be particularly important in helping to prevent hydrilla's spread.

Avoid passing through ANY dense patches of vegetation in the Cayuga Inlet or the shallow areas at the south end of Cayuga Lake. (CCET-1B)

Report New Sightings. Thirty-nine percent of the materials recommended reporting sightings of possible AIS to government agencies or other organizations. For example:

Report new sightings. If you suspect a new infestation of an invasive plant or animal, save a specimen and report it to a local natural resource or Sea Grant office. (MN-1)

If invasive plants are spreading to a new area, report the sighting to the project leaders listed on the back cover of this guide. (CCE-ON-2)

Early detection of new Asian carp populations, however, may help contain their spread and allow for their removal. Therefore your help in "watching" for new infestations and preventing the spread of these and other non-native aquatic species is needed to protect our waters. (SG-4)

Outcomes

Changing the behaviors of recreational users depends not only on describing desirable and undesirable behaviors clearly and consistently, but also on convincing people that behavior change is important. The communication materials we analyzed described a variety of positive and negative outcomes in an effort to encourage behavior change. These included negative outcomes of AIS, negative outcomes of undesirable user behaviors, and positive outcomes of desirable user behaviors. We evaluated:

- Use of fear appeals – descriptions of negative outcomes of AIS and how recreational users' behavior related to the spread of AIS; and
- Use of loss vs. gain framing – descriptions of negative outcomes of not adopting a behavior vs. positive outcomes of adopting a behavior.

Fear Appeals: Negative Outcomes of AIS. The materials listed a variety of types of harm that AIS could cause, one of the components of fear appeals (Table 16). Nearly two-thirds of the materials stated that AIS could harm the natural environment (other species and ecosystems). For example:

Exotic species ... have destroyed and disrupted aquatic communities across the nation. (SG-2)

Table 16. Percentage of materials communicating particular types of harm caused by AIS.

Component Harmed	Percentage of Materials
Natural environment	63%
Recreational use	50%
Economy	32%
Human activities (other than recreational use)	19%
Equipment or property	17%
Human health and safety	15%
Property values	15%
Water supply	10%
Tourism	4%
Aesthetics	4%

Half mentioned that AIS could harm recreational use. For example:

Enjoying the great outdoors is important to many of us. Boating, fishing, hunting, and wildlife watching are traditions that we want to preserve for our children and their children. Today, these traditions are at risk. Aquatic invaders such as round goby, zebra mussels, purple loosestrife, Eurasian watermilfoil, bighead and silver carp, and New Zealand mudsnail threaten our valuable waters and recreation. (MN-1)

One-third discussed the potential for economic damage. For example:

Infestations do have significant negative impacts on all water-associated recreational activities, particularly sport-fishing. Floating didymo stalks tangle up lines, flies and lures. Additionally, didymo blooms have blocked water intake pipes and canals. Consequently, didymo remains a serious economic concern for fisheries, tourism, irrigation, and hydropower. (NYIS-1A)

Loss Framing: Negative Outcomes of Behavior. Closely related to the descriptions of the problems caused by AIS were descriptions that some materials included of the negative outcomes of the behaviors of recreational users, which are examples of loss framing. These materials described the outcomes that could occur if users did not abide by the guidelines recommended regarding cleaning their recreational equipment and disposing of their bait properly (Table 17). Fewer than one-fifth of the materials communicate these types of messages. The most frequent message of this type communicated was that recreational users' behavior could lead to the spread of AIS. For example:

Fishing enthusiasts can unknowingly spread harmful invasive species from one waterbody into another and the results can be devastating. (SL-1)

Table 17. Percentage of materials communicating negative outcomes of recreational users' behavior (loss framing).

Outcome	Percentage of Materials
Spread of AIS	17%
Harm to the natural environment	4%
Fines or sanctions	4%
Harm to recreational opportunities	1%

Gain Framing: Positive Outcomes of Behavior. The materials we analyzed were much more likely to communicate messages about the potential positive outcomes of recreational users' behaviors (gain framing) – in particular, the outcomes that could occur if recreational users abided by behavioral recommendations (Table 18). Nearly three-quarters communicated that abiding by behavioral recommendations could help prevent the spread of AIS – achieving a positive outcome by avoiding a negative outcome. For example:

You can stop invading species. (OF-1)

A smaller percentage of materials appealed to positive conditions that could be maintained through behavior – either protecting the natural environment (33%) or protecting resource use (4%). For example:

Please help protect New York waterways from aquatic invasive species by following these guidelines. (NYParks-2)

You are encouraged to help sustain our waterways for future generations. (ANCA-1)

Table 18. Percentage of materials communicating positive outcomes of recreational users' behavior.

Outcome	Percentage of Materials
Prevent spread of AIS	71%
Protect the natural environment	33%
Protect recreational use	4%
Prevent equipment damage	3%
Avoid fines or sanctions	1%

Factors Leading to Spread of AIS

Some of the materials explicitly described ways that AIS could spread (Table 19). Because many of these materials were aimed specifically at recreational users, they often referred to the movement of recreational users or their equipment, but a number of other factors were mentioned by some of the materials.

Table 19. Percentage of materials attributing the spread of AIS to particular factors.

Factor	Percentage of materials
Recreational users' movement	43%
Recreational equipment	39%
Aquarium organisms	13%
Ballast water	11%
Water gardens	8%
Transport of bait	6%
Fish trade/stocking	4%
Clothing	3%
In water	3%
Attached to plants or animals	3%
Equipment (other than recreational)	3%
Intentional release	3%
Aquaculture	3%

Characterization of AIS

Definitions of AIS. Only 17% of the materials explicitly defined AIS. Two common components of these definitions were that AIS were non-native and that they caused harm to the environment:

Aquatic invasive species (AIS) are non-native plants and animals that threaten native plants, wildlife, and their habitats. (FLI-2)

Aquatic invasive plants are those in which a specimen from one region of the world is transported (accidentally or intentionally) to a lake or river in another, and quickly spreads to the point of crowding out native plants and animals. (CCE-ON-3)

Some definitions also specified that AIS caused harm to people:

Invasive species are non-native plants and animals that spread rapidly causing ecological and economic harm. (CCE-ON-4)

Aquatic invasive species are non-native plants and animals that can degrade a body of water, impair boating and fishing, threaten native plants and animals and destroy habitat. (NY-1)

Some materials explicitly defined invasive species as a subset of non-native species:

Alien and exotic are two words used when plants or animals are not native to an area. When such plants and animals are aggressive to the extent that they out-compete native plants and animals and disrupt the ecological balance, they are called invasive. (CC-1)

An alien species is a plant or animal occurring in an area outside of its known natural range as a result of accidental or intentional introduction by human activities. An alien species is considered invasive if its introduction and spread causes harm to the environment, economy or society. (OF-9)

Other materials did not distinguish invasive from non-native species, however:

Invasive species are plants (aquatic & terrestrial), animals, microscopic organisms, algae and other living things, that are non-native to this area. (SL-1)

AIS Terminology. A number of different terms were used when referring to or describing AIS (Table 20). Many materials used multiple terms at different places. The word “invasive” was used more than twice as often as any other term, but “invading,” “hitchhikers,” “AIS,” and “nuisance” were used frequently, too.

Table 20. Number of times terms were used to describe AIS.

Term	Number of Times Used
Invasive	148
Invading	71
Hitchhikers	45
AIS	28
Nuisance	26
Non-native	13
Invaders	10
Exotic	8
Alien	2
Foreign	2
Hitchhiking plants or animals	1
Introduced	1

Specific Species. Seventy-one percent of the materials referred to specific AIS. Forty-eight different species were mentioned. Those species that were mentioned in at least 5 of the materials are listed in Table 21.

Twenty-one percent of the materials discussed diseases as part of their discussion of AIS. Viral hemorrhagic septicemia and Whirling disease were specifically mentioned in some materials.

Table 21. Number of materials mentioning specific AIS.

Species	Number of materials
Hydrilla	20
Eurasian watermilfoil	19
Zebra mussel	18
Water chestnut	16
Round goby	15
Spiny waterflea	15
Asian clam	14
Quagga mussel	11
Curly leaf pondweed	10
Didymo	10
Fanwort	9
Fishhook waterflea	7
European frogbit	6
Silver carp	6
Alewife	5
Bighead carp	5

Links to Other Sources

Many of the materials identified other communication campaigns related to AIS or other sources of additional information.

- Forty percent referred to the “Stop Aquatic Hitchhikers” campaign.
- Thirty-three percent provided a link to the “Protect Your Waters” website.
- Sixty-one percent referred readers to other sources for additional information.

Part 3: Effectiveness and Capacity of Outreach Programs

During the interviews, the respondents offered self-assessments of: (1) the effectiveness of their education and outreach efforts targeting boaters and anglers; and (2) the factors perceived to influence the capacity of their organizations to undertake and succeed at these education and outreach efforts.

Effectiveness

Reaching Key Audiences. When interview respondents spoke about the effectiveness of their outreach efforts, they discussed several types of indicators. To begin with, they discussed their ability to reach key audiences. In this regard, the effectiveness of their programs was mixed. Some considered their programs better at reaching anglers than boaters:

Anglers have been targeted for a long time. I think they have gotten the message. Boaters, we haven't done such a great job with. (AIS-14)

The ability of organizations to reach boaters was constrained by the availability of staff:

We have one person for western New York and two people in Lake Ontario Basin. So I'm certainly not saying that Sea Grant reaches everyone that we should reach with our limited staff. (AIS-20)

I don't have enough people to cover every area, every day. (AIS-24)

Audience Receptivity. On the other hand, respondents generally considered the people they did reach very receptive to information about AIS.

If we have a table set up at some kind of show – whether it's an angling show or an environmental day ... the amount of publications that they take ... the watch cards we distribute, the factsheets that we distribute. People pick them up and want them. And it's not like you have to hand it to them and say, "Oh, here you want to take this." (AIS-20)

From our data that we've collected over the years ... what we've kind of concluded is that 90-95% of the boaters are very receptive and willing ... to listen, ask questions, or wanting to inspect their boats. And a very small number of interactions have turned negative in a way that they ... say, "No, I don't want to. I don't want you inspecting my boat." (AIS-26)

Interview respondents attributed this receptivity to a genuine concern about the problems that AIS could cause:

Certainly the people that we do interact with understand that it's a critical environmental problem. (AIS-20)

Hydrilla was in the news so much that year. We had a lot of people actually concerned. (AIS-10)

I think the anglers in particular are very accessible audiences for this kind of information because they don't want to see their favorite fishing hole become their not-favorite fishing hole, because they don't want to see the Asian clam get into their water body, or hydrilla be a problem. So they tend to be very open, very receptive. In general the recreational boaters are as well. (AIS-9)

Tournament anglers were the one group that was believed by some respondents to be less receptive to AIS outreach.

The only ... group that I've seen that isn't particularly responsive, even in areas of the Great Lakes where they have targeted these audiences and have hammered them with information, tend to be the groups like bass anglers who are going to two, three, four tournaments a month in different areas. And they pretty much act like they don't want to be bothered. They don't want to take the extra time. They're out there for a specific reason, to catch the biggest fish at the tournament. And in some areas some of them actually like there to be invasive

species. Bass anglers have figured out that there's an intersect – if you've got an aquatic plant that's providing heavy shadow in the water, that you're going to find the big fish right along the edge of the water chestnut area. (AIS-9)

Tournament anglers were viewed as particularly opposed to the passage of new laws to support outreach efforts by regulating the behavior of recreational users:

The reason it hasn't passed at the state level is that there's usually a lobby from the angling associations that this will seriously hamper commerce or the fishing tournaments and it's a nuisance. So we have to change the way they think about it so that they appreciate the risk they take by not taking some simple cleaning measures. (AIS-21)

Awareness. Receptivity to AIS-related messages is closely related to awareness about AIS. Most respondents believed that many recreational users were aware of AIS and the problems they cause; they often attributed at least some of this awareness to effective outreach programs:

I think the outreach effort in general ... actually has been pretty successful. I mean a lot of people were aware of what was going on [related to local AIS] last year. (AIS-28)

Going back and looking at the experience from 1990, when the zebra mussels first started to show up and we first started to really hit the boating community and angling community with information, I would say today it would be unusual to find someone who's a repeat boater or angler on Lake Ontario who doesn't have at least a general awareness of invasive species and why it's important that they should know about them. (AIS-9)

Furthermore, many believed that recreational users were able to understand the relationship between their own actions and the spread of AIS.

The boaters seem quite concerned because they seem to be making the connection between their activities and the potential to either hurt or help the aquatic environment as far as AIS are concerned. (AIS-24)

Behavior Change. Respondents questioned, however, whether increased awareness was leading to a change in behavior:

I think it's effective to a certain point. Getting information in someone's head is one thing. Getting them to act on that information is another. (AIS-18)

Most of our respondents were uncertain of how much behavior change had actually occurred:

Maybe this year we'll find more people actively doing it because outreach efforts through last year and the start of this year may be more present in people's minds... It would be interesting to ask that question. I'm not sure if I'd be able to look back at our data and say it has or it hasn't. (AIS-26)

I'm not sure how many of them act on it ... It goes back to one of those measuring things. I don't know a way to measure that unless we got their information, their address, their phone number and followed up with a survey or something three months later and see if they made any changes. (AIS-30)

Some respondents, however, were confident that outreach had indeed influenced recreational users' behavior:

I think that it is much more common now for someone when they pull their boat out of any water ... where some of the really targeted education has been... We haven't done any direct statistically evaluatable studies here in the state yet but I would, just from observation, I would say that a lot of our anglers and recreational boaters are doing those sorts of things to clean their boat, clean their trailer. (AIS-9)

Respondents also believed, however, that some AIS-related recommendations were particularly difficult to get people to adopt. The washing and drying of recreational equipment in particular were considered infeasible under some circumstances. Washing boats can be difficult if no washing facilities are readily available:

If you're at a marina and you take out your boat ... and nowhere for them to wash it off, either at all or safely so it doesn't go back into the water, then how could he comply with that? (AIS-15)

Not only is compliance sometimes impractical, but it can also put equipment at risk:

If we can provide a simple [recommendation], like all right here's Formula 409, kills all invasives ... I think compliance will probably be fairly certain. But if you're trying to get people to disinfect with 140° hot water when it's not necessarily available at a car wash ... I can't see that happening. I mean it comes to a point where a person has to judge what's the greater risk ... spread of invasives or damaging my brand new ... motor... Some of these recommendations ... it's fairly dangerous to equipment you know. (AIS-13)

Recommendations for drying equipment were also seen as impractical for some boaters:

The overall recommendation is 5-7 days on the trailer, if possible in an area where it's going to get sun. So it's not just sitting in a barn or a garage, but it's getting sun on it. Or if it's in a garage, you'd want to know that that garage is getting hot inside, getting up to the point where any vegetation is going to either dry out or any organism is going to die from either the heat shock or asphyxiation as it dries out. Weekend boaters, you know they launch their boat in Rochester on Saturday morning and take it home Sunday evening, that type of recreational boater, that's usually not a problem because it's going to sit there on the trailer anyway... Your folks who go from place to place, you know the vacationer who's going through New York ... they may be dipping their boat in every Great Lake they come to and then driving to the campground that they're staying at tonight – so that boat is out of the water but it's not out of the water long enough... Bass anglers, they come into a tournament,

they whip the water to a froth fishing, and then they leave and they may be going two states away for a tournament that starts tomorrow. So they're a tougher one. (AIS-9)

Effectiveness of Different Outreach Activities. Respondents did have opinions about which types of outreach activities were most likely to be effective. Many considered watercraft steward programs particularly effective:

So all the stewards that are employed at our boat launches and stuff, they're really valuable. I think that's probably one of the best outreach tools out there is – the boat launch steward program. (AIS-13)

I don't know how well it's working quite yet, but I do know that from those that I've spoken to and when I've been at the launches and the stewards have been there, for the most part they're well received. And people at least give them the five minutes that they're asking for to hear their message. And then maybe ... if they see the composting bin there, they're more apt to take those few extra steps to throw the vegetation in there rather than just driving away and hoping it blows away. (AIS-23)

One respondent, however, was concerned that the stewards were often having contact with the same group of individuals repeatedly:

There's a lot of repeats ... So I'm not sure that's the most ... effective use of their time. (AIS-15)

Presentations were also considered effective outreach tools by some respondents – and more effective than printed outreach materials:

We've found that probably one of the more effective things that we do in terms of outreach is not necessarily printed materials but presentations, actually having someone stand before an audience, talking with them, showing them slides for example, maybe some hands-on stuff. That seems to be we think one of our most effective outreach methods (AIS-18)

Effects on AIS Movement. The ultimate question is whether outreach helps to prevent the movement of AIS. This question was viewed as particularly difficult to answer:

One of the drawbacks I think is measuring when we've been successful. So you know we don't have snakeheads right now that we know of in western New York. But is that because our education message has worked or is it just luck that they haven't made it this far? And I'd love to be able to measure that, but it's hard to measure something that doesn't happen... Are we just giving out a bunch of watch cards that people take home and throw in the garbage, or are they actually preventing something? Are they actually effecting some kind of change? (AIS-30)

Capacity

The capacity for AIS prevention efforts was determined both by the characteristics of individual organizations working on these efforts and by the networks through which these organizations interacted. Salient characteristics of organizations included:

- The priority they placed on AIS prevention relative to other activities.
- The authority and credibility the organizations had related to AIS.
- The resources they could devote to AIS outreach, including funding, equipment, facilities, information, and labor.

We consider each of these characteristics as well as how networks contributed to increased capacity.

Priority on AIS Prevention. Because we targeted organizations that we believed to be engaged in AIS outreach work targeting recreational users, it is no surprise that many of the individuals we interviewed indicated that their organizations placed a high priority on AIS work:

Our invasive species work, especially within the ... Great Lakes ecosystem ... it ranks pretty high. We see invasive species as one of the biggest threats to biodiversity within the Great Lakes system, so we do target a lot of our resources towards invasive species management. (AIS-18)

Not only the organizations, but the individuals within the organizations, often considered AIS work such a high priority that they were willing to do “whatever it takes.”

Whatever it takes. And even if we lose sleep and we don't get paid for everything, we have to do this because it's for the good of the resource, which is our beloved water, our creeks, and our lake. (AIS-2)

Although all of the individuals we interviewed had some interest in AIS, the emphasis they placed on AIS in relation to their other priorities varied. For some, AIS were a primary focus, but for others AIS were only one part of a much more comprehensive program.

Most of the concerns I have ... would be agricultural insect pests, #1, and terrestrial invasive species... So aquatic invasives, that's kind of a secondary issue in a way. (AIS-12)

Authority and Credibility. Many of the individuals we interviewed worked for organizations, such as Sea Grant or Cornell Cooperative Extension, that were well understood to have a role in AIS education and outreach. Others worked for organizations in which outreach work was not their primary focus. In these organizations, engaging in AIS outreach work typically had to be authorized and directed by higher levels of the organization:

We go in the direction ... at the local level that the province goes. So at this point we have a strategic direction, we have an Ontario invasive species strategic plan, and that sort of directs ... where our work should go. (AIS-14)

If I wanted to put some posters up, I would just clear it with the regional office. I'm sure that there wouldn't be any problem with it. But other than a small piecemeal effort, we pretty much wait for directives from above to catch up with us. (AIS-1)

If higher levels within an organization do not support the work, it can founder:

Their executive staff was not in favor of that, and still is not in favor of that, and so the education work that is done is very regionalized. Which is fine but there's no central direction for that. Or resources. (AIS-19)

She always said ... you can make this job what you want it to be. But then when I was interested in doing specific things it was always ... no, no, no. So basically I'm just working on projects as they come up, and I don't really direct the work that I do necessarily. (AIS-19)

Some organizations engaged in planning processes as a way to legitimize and direct their work on AIS:

With outreach I think we've identified three primary objectives, which focus on educating various user groups. (AIS-3)

Previous to that we did do work on invasive species but it was sort of ... [a] reactionary-type thing... If it was an outreach-type activity, it was just sort of an opportunity that came up... So we've actually had this program for the last four years now ... We ... plan and try to develop strategy in terms of what we're doing. (AIS-32)

Outreach efforts aimed at changing the behavior of recreational users were bolstered when regulations were in place requiring certain behaviors. These requirements could then be communicated as part of outreach. For example, Ontario has a law regulating disposal of live bait:

Our regulation in Ontario is that they must dispose of it 30 meters from shore, including the water. (AIS-14)

Often, however, regulations mandating desired behaviors were not in place, and so outreach efforts did not have this support:

It is not a provincial regulation ... that you can't transport an aquatic plant ... in terms of the boat and equipment. (AIS-14)

Consequently, some respondents spoke of the need to establish new laws and regulations:

The big lack I think is creating laws, an actual deterrent for the transfer of these species. If you could be ticketed if your boat's driving down the road and it's muddy and it's got vegetation on it, that's motivation for somebody that may not care about invasive species or they don't see the value in it... You can create as many local laws as you want, and they'll

never ever be enforced. So statewide laws, that's where I feel that we've got the least amount of support. (AIS-31)

We currently are in ... a rule-making process that we're hoping to move forward that's going to make ... it illegal for a person to launch a boat or leave the site with visible invasive species... That's in early stages and we don't know where that's going to go, but that's what we're proposing. (AIS-13)

One characteristic of organizations that legitimized their outreach work and enhanced their capacity was the opportunity they had for contact with recreational users. Interview respondents from New York State indicated that boaters were a harder audience to reach than anglers:

There's in excess of 300,000 boat owners in New York State. The only way to communicate with that audience is every three years when they get their registration form. (AIS-29)

When the zebra mussel first showed up, we were able to get nice little slip sheets put in the mailings that went out from DMV to everybody who had to register a boat trailer. Now a lot of that's done online now and so that little slip of paper with a picture of an invasive species on it isn't going to come out of the envelope along with the re-registration packet. (AIS-9)

Organizations that managed parks and other aquatic access points were viewed as having the best opportunity to reach boaters:

If we had a bunch of posters we could ... two of the parks, Westcott Beach and Long Point, have boat launches. So I've got two separate boat launches, two boat launches within two of the parks. (AIS-1)

I oversee a network of close to 400 boat launches in the state. (AIS-13)

Recreational users' organizations, when they participated in outreach efforts, also had the capacity to reach individual users effectively.

We are a membership-driven organization. So we're quite effective at getting the word out there because a lot of our members are outdoor enthusiasts, they are recreationists, they are engaged in these activities. And then beyond that they are members of different clubs and different angling groups and communities. So they are able then to take what messages we have put forward ... and share them within their communities as well. (AIS-27)

Resources. Resources, such as funding, staff, information, and materials, made a key contribution to the capacity of organizations to implement AIS outreach programs. Funding was an obvious constraint on outreach capacity, and its availability influenced whether and how organizations became involved in AIS outreach:

The last couple of years we're seeing a lot of the organizations that we used to work with unfortunately aren't there or have been cut to the bone because of the recession and the loss of whatever was funding them. And so we're seeing organized partners disappearing. (AIS-9)

We're short on outreach funds. They got short shrift last year and there's no official funding for them this year. And that's a problem because without proper outreach you can unravel the whole effort. (AIS-21)

I would say the limitation ... of the Watercraft Steward Program is that we can only be at one launch 40 hours a week. When fishermen go out early morning to late at night and weekends and holidays that's more than 40 hours a week... I know we would love to have more stewards in more places for longer hours, but that's just the limitation of the funding right now. (AIS-26)

However, some respondents argued that funding, while not able to support all conceivable activities, was available:

I think that the funding we have now is ... probably one notch below adequate, but not too bad. There's always more that can be done ... but ... we're grateful for what we get... Occasionally there are initiatives that come up that we want to undertake that we don't have the funding for, so trying to fund those particular initiatives is a challenge. (AIS-18)

Under these circumstances, grant funding is critically important to sustain outreach programs. Great Lakes Restoration Initiative funding in particular has been helpful:

We're getting some funding through the Great Lakes Restoration Initiative which has been huge – a huge boom for our program. (AIS-30)

As long as we have GLRI funding it looks like there will be continued effort. But funding continues to be a question and ... we do not fund any of our steward programs that I work on. We don't fund any of that internally. Those are all grant-funded projects. So in the near future we seem to be okay. As far as how long we can continue, I can't comment to that. It just depends on the funding. (AIS-24)

The uncertainty in whether and how much funding will be available, however, undermines the effectiveness of outreach programs.

We don't get a lot accomplished. I'd rather be out doing something. So I think that the lack of clarity as to what funding is available and who's going to get it when, it just ends up wasting a lot of effort. (AIS-28)

Funding constraints have also forced cooperation, and that has led to some improvements in the consistency of programs:

When you talk about the Stop Aquatic Hitchhiker campaign and you talk about the New York Invasive Species Clearinghouse website, I think in some regard they're as successful as they are because we don't have resources... There's a lot of people like, "Well, I'd like to develop my own logo. I think I'll do this." And you know, "Instead of calling it 'Stop Aquatic Hitchhiker' we're just going to say 'Stop Hitchhiking.'" ... In the '90s ... you never knew

what you were going to get next... It all basically was the same concept but with a different logo and a little different focus and a little different font... I think those two sites have become as successful as they are because people said, "Okay, I can go get the material I need for next week's display. I can order it online and have it delivered tomorrow. I don't have to design a thing." ... I think ... we have seen success ... because ... people don't have the resources to be as creative on their own. (AIS-29)

The adequacy of the number of staff members that organizations had available to work on AIS outreach was also widely viewed as having an important influence on their capacity to implement outreach programs.

It's staff time and expertise. So with myself, 15-20% of my position, and then we have another individual who ... probably puts in maybe 5-10% right now. (AIS-15)

It is what it is... In terms of the outreach we provide, we do as best we can with the limited people we have. We do not have any ... staff dedicated to this effort. (AIS-13)

We just don't have the capacity to do that... Certainly if we had more staff we could do more in the landscape in terms of control and in terms of outreach. We could attend more events ... to improve getting the message out there. (AIS-32)

The number of staff available is obviously heavily influenced by the amount of funding available:

Traditionally it's been a full time position and due to funding cuts it has had to get reduced to part time. And the educator who is in this position was a great, great guy, but he has been retirement eligible for some time. So he chose retirement instead of going to part time. (AIS-12)

Some interview respondents said that it was particularly important to have funding for someone to coordinate AIS outreach work:

It's the adage, it's about money, and it's all about money. You really need a paid coordinator. You really need some kind of funding and a point of contact person to spearhead this activity. (AIS-22)

One way that organizations sometimes supplemented the work of staff was by recruiting volunteers:

We do take advantage of volunteer resources, which provides non-monetary work to the effort. (AIS-18)

It is not simply the number of staff members that provides capacity, however. Staff must also have the appropriate types of expertise. Having staff members with strong scientific credentials as well as staff members with an understanding of outreach work were both important:

I have completely had to rely on the scientific reliability ... of the other people on the team, the scientists and the experts, to evaluate what's going on... I'm very good on outreach ... translating scientific to regular speech. I've done that for many years and in many different ways ... but I also ... know where my limits are. (AIS-2)

We have a strong ability to provide the community outreach that oftentimes goes alongside research ... They kind of work together... A grant last year ... included ... field research on bloody red shrimp, but on top of it ... was the outreach component and the stewards program, too. So that was kind of bundled in one. (AIS-26)

A closely related type of resource that contributed to the capacity for outreach efforts was the availability of information. A number of respondents believed that ample information was available about AIS and how recreational users contributed to their spread:

I feel fairly confident in informational resources. (AIS-24)

Indeed, a number of individuals invested time in gathering information about AIS:

I'll turn to academic papers. I try and keep up on the latest and greatest... And conferences as well, workshops. (AIS-14)

We needed to have all of the research that we could get our hands on... I don't know how many papers I read on hydrilla, but I had a huge stack at one time on my desk and I used to go through them so that I had all those facts and I could reference all of those studies. (AIS-31)

Sea Grant, Cooperative Extension, and universities were considered key sources of scientific expertise and resources for other organizations without such expertise:

Much of what we're talking about is driven by research that's been conducted by Sea Grant researchers. So ... we are bringing science-based information... So we feel pretty secure when ... we're extending their research to a greater audience. So I think that's a strength. Certainly the fact that many of us have this as an area of specialization so we ourselves have put a great deal of time and energy into staying up to date on the information. (AIS-20)

If there's ever any kind of Cooperative Extension invasive species training, I try to attend. Or I also have another employee who has ... been involved in invasive species education. So ... one of us try to attend. (AIS-15)

Sea Grant was considered very effective at developing AIS-outreach messages that were thoroughly grounded in the best available information:

Our strengths lie in the message, ensuring that it is you know research-based, good solid information, correct information and objective information. (AIS-29)

They also make a concerted effort to get that information into the hands of those who might be involved with education and outreach efforts:

That program is targeted to two general groups: one group being teaching the county Cooperative Extension educators about invasive species issues so they can become the multipliers of giving that information out. The second audience is ... members of PRISMs¹ ... the PRISM winds up being the multiplier (AIS-9)

Many of the organizations worked actively on sharing the information about AIS they had available with other organizations and with the public. Cornell Cooperative Extension of Tompkins County maintains a website focused on hydrilla. The New York Invasive Species Clearinghouse is a website maintained by Cornell Cooperative Extension and New York Sea Grant (and funded by the NYS Department of Environmental Conservation) with numerous information resources available about invasive species. Protectyourwaters.net is the website of the national “Stop Aquatic Hitchhikers!” campaign.

The availability (or lack thereof) of outreach materials was another influence on the capacity of outreach programs. Many organizations who might otherwise be involved in outreach work were not in a position to develop outreach materials on their own. Consequently, websites such as protectyourwaters.net and the New York Invasive Species Clearinghouse made materials available for others to use:

The NYIS website has great, great information on it. It's all print on demand. If somebody calls me and says, “Can you send me 500 factsheets?” I'm going to say, “No, but you can print them out on your printer.” ... The product is there. (AIS-29)

Nevertheless, some respondents believed that there was a lack of materials that were tailored to specific local contexts.

Oftentimes you'll find outreach materials that are species-specific, but they're not specific to the Finger Lakes region. Like which lakes have what species. That's a challenge... Which lakes have Asian clams? Which vectors are important? ... So we do try to make our documents localized. (AIS-26)

Networks. One overarching factor that contributed to the capacity of outreach efforts in the Lake Ontario basin were networks of and interactions between organizations working on outreach. Such interactions were frequently mentioned during interviews:

I also work with the fisheries managers at DEC just to keep them in the loop and identify any issues... Also at DEC is an invasive species group. We're also linked with them. Cornell's ISP program, the local PRISM, my colleagues at Sea Grant as well as the other Great Lakes Sea Grant network programs. Other states are also doing watercraft inspection, so there are occasions where I need to be in touch with those folks in other states as well. (AIS-24)

¹ Partnerships for Regional Invasive Species Management. Eight PRISMs were created in New York State “to coordinate invasive species management functions including coordinating partner efforts, recruiting and training citizen volunteers, identifying and delivering education and outreach, establishing early detection monitoring networks and implementing direct eradication and control efforts.” (http://nyis.info/?action=prism_partners)

The PRISMs in New York were one of the key networks for those with AIS-related concerns:

It seems like the PRISMs could be a very good way for New York to get outreach out, to get work on the ground accomplished, to identify priorities and invasive species needs throughout the state. (AIS-17)

It is the PRISM... It really has the energy and the driving force behind invasives work in the eastern basin of Lake Ontario (AIS-18)

The PRISMs played a particularly important role for organizations that might have some involvement in AIS-related work, but were not in a position to devote substantial resources to it:

My main involvement is through the PRISM. (AIS-1)

I try to listen at the PRISM ... when I can. I'm hoping once the PRISM starts again it might be a little easier. (AIS-10)

New York Sea Grant also benefitted from being part of a larger network, which extended well beyond the Lake Ontario basin – the network of Sea Grant programs throughout the Great Lakes region:

Those are network projects ... I'm referring to the Sea Grant network, so that's seven programs representing the eight Great Lakes States. (AIS-20)

In Ontario, one of the key partnerships was that between the Ontario Federation of Anglers and Hunters and the Ontario Ministry of Natural Resources:

So my group is primarily a policy group ... around invasive, aquatic invasive species policy. However ... we're also the group that's responsible for the partnership ... with the Ontario Federation of Anglers and Hunters to run the Invading Species Awareness Program, which is the group that does most of our education and outreach. (AIS-25)

Other networks contributed to AIS outreach programs, too. Various respondents spoke of networks between local organizations addressing local AIS issues, networks within statewide agencies that had AIS outreach programs as one part of a larger set of activities, networks with businesses that had the capacity to reach recreational users, and networks with local government agencies.

These networks built the capacity of outreach efforts in a variety of ways and contributed to many of the key resources described above. They served as a way for organizations to secure outreach materials:

New York Sea Grant and Finger Lakes Institute really just provide us with a lot of materials. (AIS-7)

Networks increased the number of recreational users that can be reached through outreach programs:

We assist each other as well. So their staff and our staff work together... Two people on a snowmobile can cover a lot of ground and speak to ... about 1,000 anglers each year depending on ice conditions. (AIS-14)

Networks increased the efficiency with which recreational users are reached and outreach materials are developed:

They're covering part of Lake Ontario only... We'll cover a few of the sites that they're not able to. We'll swap with them depending on ... where their potential stewards are from geographically... If we don't get any applicants from up north, but we have someone that's from one of their home sites, we could share a steward. (AIS-26)

We're now trying to work with all the PRISMs to say, "Hey, how about if all of you folks put in a master order for cards? ... Instead of each one of you getting 1,000 made at one dollar apiece, why don't you all go together and you can get 10,000 made for 50 cents apiece?" (AIS-29)

Networks served as sources of expertise and information:

Our relationships with scientific experts in the region – we have established relationships with them. So in-house we have a smaller staff, but we work alongside [experts] ... we can get information verified and shared... We have good networks in terms of resources, information resources. (AIS-26)

Although most respondents' characterizations of interactions between organizations working on outreach were positive, some respondents also mentioned that competition for funding sometimes existed within networks:

When we work with some of these other organizations, it is a little tricky because some of us compete for the same grants. So that can sort of damage relationships and the relationships are hard to build... And that definitely influences the perspective received by our audience and how we can be effective sometimes. (AIS-7)

As with any funding ... it's highly competitive... You have a lot of organizations involved with invasive species which increases the competitiveness of the proposals. But ... you can kind of collaborate on priorities. (AIS-18)

Others pointed out that communication and the exchange of information was not always as seamless as it could be:

At the time that we needed this was in February. Whether [they] had a rack card at that time I'm not even aware... 'Cause they didn't come out in a massive email to all outreach

coordinators... So I'm not sure how it was supposed to travel through or across my desk... I'm glad it did eventually, but it wasn't a systematic way. (AIS-26)

We do definitely probably create the same types of materials and just don't know it. (AIS-7)

Ultimately, these networks also enabled organizations to increase the consistency of their outreach efforts:

And so although [our organization] is not directly responsible for the implementation of those programs, we're kind of the central point of contact ... so that they can share information, learn what needs to be done, talk about budgets and money and how to get these programs funded, and hopefully, eventually create a seamless boat launch steward program across not only the Finger Lakes but throughout the Lake Ontario basin and then even beyond that to Lake Champlain and other areas that could benefit from this type of program. (AIS-23)

The importance of consistent messaging and approaches to outreach was stressed by many interview respondents:

In terms of what our staff will be saying to people ... and the messaging ... we always try and be very consistent with the inspect, clean, drain messaging... I think the consistency leads to correct behaviors. (AIS-14)

I was thrilled because the clean, drain, dry message is what they use. So it's like, yes, we're using the same message. That's great. Consistent messaging is supposed to be very effective for communicating better with people. (AIS-19)

Some of the organizations devoted considerable energy to trying to ensure more consistent messaging.

New York Sea Grant is actually ... going to do a training for as many lakes as possible so that we can standardize the boat stewarding program across the entire state. Because so many groups are getting involved, it's almost a little out of hand. (AIS-7)

We try to coordinate whatever we're doing with ... the other divisions in our agency ... the 39 boat launches we have and the campgrounds. So obviously our message is consistent within our agency. But we also try to work also with [other agencies] to see that they adopt ... the same messaging and we've been doing more of that recently. (AIS-13)

One challenge in maintaining consistent messaging is that some organizations were unsure who should be making the final decisions about key messages:

We're not quite sure who we need the approvals ... from for this consistent messaging. (AIS-26)

In other cases, different organizations had difficulty reaching agreement about an approach:

I discussed with ... the person who was ... in charge of any aquatic invasive-related ... outreach... And he said, "Well, this is the one we like. This is the best one." And that was the final word on it... They had the final word... I know it's not the best sign you could have.
(AIS-19)

Part 4: Social Networks and Their Influence on Messages

We assessed the degree to which organizations that tended to rely on the same organizations in the course of their work on AIS outreach communicated similar outreach messages. We predicted the emphasis each individual we surveyed would place on communicating each of 16 possible outreach messages. The predicted emphasis for each message for each respondent was the weighted average of the emphasis placed on that message by all other individuals in the network (where the weights used were the strength of the relationship between each pair of individuals as represented in the affiliation matrix as described in this Methods section). We calculated the correlation between the predicted emphasis on each message and the actual emphasis on each message for each of the 16 different messages.

We found significant positive correlations between the predicted and actual emphases that respondents placed on 15 of the 16 messages (Table 22). The strength of these correlations varied. These correlations demonstrate the influence that social networks of individuals working on AIS outreach can have on message consistency. Individuals that were strongly linked in the network because they relied on the same set of organizations in their AIS work (whether for information, advice, or other reasons) were more likely to emphasize similar messages in their outreach programs. Because individuals relying on the same sources of information tended to communicate more consistent messages, the consistency of messages may be improved by continuing to encourage organizations to rely on common information sources in their work (e.g., NYIS Clearinghouse, Protect Your Waters, etc.).

CONCLUSIONS

Our research identified a number of indicators of effective outreach to recreational users in the Lake Ontario basin about AIS. Numerous organizations devote at least some effort to encouraging behavior change in boaters and anglers. Although the specific messages communicated vary depending on the target audiences, local conditions, and the method of communication, the behaviors recreational users are being encouraged to adopt are largely consistent.

A variety of methods has been used to reach target audiences with watercraft stewards viewed by many as a particularly effective approach. Recreational users are perceived to be aware of and concerned about AIS and receptive to outreach messages.

Table 22. Correlations between predicted and actual emphases placed by respondents on each of 16 different outreach messages.

Message	Adjusted r^2	p
Inspect fishing and boating equipment for attached aquatic plants and animals	0.445	0.000
Run your boat engine after you remove it from the water	0.239	0.007
Remove any visible mud, plants, fish or animals before transporting fishing or boating equipment	0.520	0.000
Learn to identify aquatic invasive species	0.225	0.008
Drain all water holding compartments including live wells, bait wells and bilge areas	0.629	0.000
Do not pass through aquatic plants in your boat	0.252	0.005
Dry boats, trailers and all fishing or boating equipment before use in another water body	0.226	0.008
Disinfect or rinse with hot water anything that came into contact with water before reuse	0.379	0.000
Report sightings of aquatic invasive species	0.289	0.003
Use only locally bought bait	0.282	0.003
Unused live baitfish may be taken home	0.130	0.039
Unused live baitfish may be thrown back into the water where you caught them	0.094	0.074
Unused live baitfish may be disposed of in the trash	0.462	0.000
Unused live baitfish may be disposed of on dry land	0.306	0.002
Unused live baitfish may be given to other anglers to use	0.141	0.033
Unused live baitfish should not be thrown into a body of water other than the water where you caught them	0.139	0.038

Many of the organizations involved in this work have recognized the benefits of working cooperatively. Cooperation has helped organizations to secure outreach materials, increased the number of recreational users that can be reached, enhanced the efficiency of outreach work, increased access to sources of expertise and information, and improved the consistency of outreach messages. Outreach programs appear to have benefitted from the establishment of common sources of information both within the Lake Ontario basin and the wider Great Lakes region.

The capacity of outreach programs, however, is constrained by funding and staffing. Although these programs are believed to be effective at communicating with the recreational users they reach, the number of people that can be reached is limited by funding and staff constraints. Certain audiences, such as tournament anglers, are perceived to be less receptive to AIS recommendations than other recreational users.

Although outreach messages are generally consistent, messages about how to wash and dry recreational equipment are less so. Multiple sets of guidelines are available for how to wash and dry equipment. One reason for a variety of guidelines is that many of these recommendations are difficult (and sometimes impractical) to implement, requiring specialized equipment, hot water,

particular cleaners, or extended periods of time. A variety of guidelines can, therefore, give individuals options from which to choose. Nevertheless, it is easy to imagine that multiple guidelines could be confusing, particularly when the guidelines are different in different sources of information. Continuing to promote certain organizations as common sources of information for developing outreach materials could help to improve this consistency.

Despite the apparent receptivity of boaters and anglers to outreach programs and messages, little concrete evidence exists as to whether they have adopted recommended behaviors and whether particular outreach programs have encouraged these behaviors. Future research to meet these needs would be valuable, including:

- Research to assess whether anglers and/or boaters are following recommendations to prevent the spread of AIS. It may be particularly worthwhile to study audiences of special concern (such as tournament anglers) and behaviors of special concern (such as washing and drying equipment).
- Research to document the impacts of *particular types* of outreach programs (e.g., posting signs, watercraft stewards, distributing brochures) on user behavior. Experimental work would be most valuable at assessing impacts and could be used both to improve outreach programs and inform the designation of resources to support particular types of programs.

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APPENDIX A: TELEPHONE INTERVIEW QUESTIONS

- First, could you tell me what position you hold and how long you've been in that position? How have you been involved with efforts to manage aquatic invasive species?
 - What other job responsibilities do you have that aren't related to aquatic invasive species?
 - How much attention do you devote to invasive species management in comparison to your other responsibilities?
- What roles does your organization play in managing aquatic invasive species? What is your organization trying to accomplish with regard to aquatic invasive species management? What objectives do you have related to the management of aquatic invasive species?
 - How does your work on aquatic invasive species relate to the overall goals of your organization?
 - What types of legal authority does your organization have that allows it to regulate activities that could contribute to the spread of aquatic invasive species?
- How does your organization try to accomplish its objectives related to aquatic invasive species management? What specific activities or efforts does it undertake?
 - What educational or outreach activities targeting boaters or anglers does it have? What educational or outreach activities targeting other groups does it have?
 - What behaviors of boaters or anglers are these efforts trying to influence? What behaviors are you trying to discourage? What behaviors are you trying to encourage?
 - What specific messages do you try to communicate to boaters and anglers?
 - About boaters and anglers' behaviors?
 - About the impacts of aquatic invasive species?
 - About how aquatic invasive species spread?
 - About what your organization is trying to accomplish related to aquatic invasive species?
 - About any other topics?
 - What other organizations do you partner with in your work on aquatic invasive species?
- What types of resources does your organization have that contributes to its aquatic invasive species prevention efforts?
 - What sources of funding does your organization have to support its invasive species efforts? How stable and consistent is this funding? How adequate is this funding to address the most important priorities your organization has related to invasive species?
 - How many staff work on to these efforts? What kinds of expertise do these staff have?
 - What kinds of data or information does your organization have available about aquatic invasive species in the Lake Ontario basin?
 - What equipment, facilities, or other types of resources does your organization have that contributes to its aquatic invasive species prevention efforts?

- How adequately do you think your organization reaches boaters and anglers with its aquatic invasive species prevention efforts? What do you think their understanding of aquatic invasive species currently is (their existence, their impacts, their importance, their spread, etc.)? How receptive do you think boaters and anglers are to the messages they receive from your organization?
- Do you have any print, web, or other materials your organization has produced to communicate with boaters and anglers about aquatic invasive species? Would I be able to get copies of these materials or guidance in how to access this information?
 - How do you distribute these materials? Do other organizations help you distribute them?
- The interview I'm conducting with you is one of a series of interviews I'm conducting. I'm trying to reach all organizations working on aquatic invasive species prevention efforts in both the U.S. and Canadian side of the Lake Ontario basin. Are there other organizations or individuals you think I should try to speak with?
- Later this spring or early this summer, we're going to conduct a short survey of people like you who work for organizations trying to prevent the spread of aquatic invasive species. The survey will help us find out which organizations are working with which other organizations by sharing information, collaborating on particular projects, or in other ways. Would you be willing to participate in that survey? We'll administer the survey by email. Would you confirm your email address for me?

APPENDIX B: WEB-BASED SURVEY INSTRUMENT

Aquatic Invasive Species Education and Outreach Networks

Cornell University is conducting a survey of individuals who work on outreach and education related to aquatic invasive species in the Lake Ontario basin – particularly outreach efforts targeting recreational users of aquatic resources, such as boaters and anglers. We are interested in what organizations are trying to accomplish through their outreach efforts, the methods they use to try to accomplish it, and how they work together or share information with other organizations. The results of this survey will help people who work on AIS outreach efforts to understand how the work they are doing relates to the work of others.

Your participation in this survey is voluntary, but we strongly encourage you to respond. A high response rate is needed for the results to adequately characterize the outreach efforts we are documenting. The questionnaire should take about 20 minutes to complete.

Although information about your organization's interactions with others will be presented in our results, that information will be based on data collected both from you and from others. In any reports arising from this work, we will keep your name confidential and will not associate your individual responses with your name.

1. We are interested in how much effort you devote to *aquatic and terrestrial invasive species* compared to your other responsibilities. In the past two years, how much time have you spent on work related to *aquatic invasive species* work related to *terrestrial invasive species*?

- 1=No time
- 2=Only a little time
- 3=A moderate amount of time
- 4=A great deal of time

	No time		A great deal of time	
a. Aquatic invasive species	1	2	3	4
b. Terrestrial invasive species	1	2	3	4

[If answer to “a” is “1,” skip to end of survey.]

2. In the remaining questions, we ask specifically about *your work related to aquatic invasive species*. How much of an emphasis does your program place on trying to accomplish each of the following outcomes *through its work related to aquatic invasive species*?

- 1=No emphasis
- 2=Only a little emphasis
- 3= A moderate amount of emphasis
- 4=A great deal of emphasis

	No emphasis		A great deal of emphasis	
a. Prevent the introduction or spread of aquatic invasive species	1	2	3	4
b. Control or eliminate existing populations of aquatic invasive species	1	2	3	4
c. Reduce the negative impacts of aquatic invasive species	1	2	3	4
d. Raise awareness about aquatic invasive species	1	2	3	4
e. Change behaviors that lead to the spread of aquatic invasive species	1	2	3	4
f. Provide people with the information they want or need about aquatic invasive species	1	2	3	4
g. Increase the availability of research-based information about aquatic invasive species	1	2	3	4
h. Build public support for management actions related to aquatic invasive species	1	2	3	4

- | | | | | | |
|----|---|---|---|---|---|
| i. | Detect new populations of aquatic invasive species | 1 | 2 | 3 | 4 |
| j. | Foster collaboration between organizations doing work on aquatic invasive species | 1 | 2 | 3 | 4 |

3. In your work, do you contribute to any education and outreach efforts *related to aquatic invasive species*?

- Yes
- No [*Skip to Question 8.*]

4. Do your education and outreach efforts try to influence the behavior of any of the following target groups? [Check all that apply.]

- Boaters
- Anglers
- Other groups that may include many people who boat or fish [e.g., lakeshore property owners]
- None of the above [*Skip to Question 8.*]

5. How much of an emphasis do you place on communicating each of the following messages in your education and outreach efforts *to boaters, anglers, or other groups that may include many people who boat or fish*?

- 1=No emphasis
- 2=Only a little emphasis
- 3=A moderate amount of emphasis
- 4=A great deal of emphasis

- | | | No emphasis | | A great deal of emphasis | |
|----|--|-------------|---|--------------------------|---|
| a. | Inspect fishing and boating equipment for attached aquatic plants and animals | 1 | 2 | 3 | 4 |
| b. | Run your boat engine after you remove it from the water | 1 | 2 | 3 | 4 |
| c. | Remove any visible mud, plants, fish or animals before transporting fishing or boating equipment | 1 | 2 | 3 | 4 |
| d. | Learn to identify aquatic invasive species | 1 | 2 | 3 | 4 |
| e. | Drain all water holding compartments including live wells, bait wells and bilge areas | 1 | 2 | 3 | 4 |

- | | | | | | |
|----|---|---|---|---|---|
| f. | Do not pass through aquatic plants in your boat | 1 | 2 | 3 | 4 |
| g. | Dry boats, trailers and all fishing or boating equipment before use in another water body | 1 | 2 | 3 | 4 |
| h. | Disinfect or rinse with hot water anything that came into contact with water before reuse | 1 | 2 | 3 | 4 |
| i. | Report sightings of aquatic invasive species | 1 | 2 | 3 | 4 |
| j. | Use only locally bought bait | 1 | 2 | 3 | 4 |

6. How much of an emphasis do you place on communicating each of the following messages about *what to do with unused live baitfish* in your education and outreach efforts *to anglers or other groups that may include many people who fish?*

- 1=No emphasis
- 2=Only a little emphasis
- 3=A moderate amount of emphasis
- 4=A great deal of emphasis

- | | | No emphasis | | A great deal of emphasis | |
|----|---|-------------|---|--------------------------|---|
| a. | Unused live baitfish may be taken home | 1 | 2 | 3 | 4 |
| b. | Unused live baitfish may be thrown back into the water where you caught them | 1 | 2 | 3 | 4 |
| c. | Unused live baitfish may be disposed of in the trash | 1 | 2 | 3 | 4 |
| d. | Unused live baitfish may be disposed of on dry land | 1 | 2 | 3 | 4 |
| e. | Unused live baitfish may be given to other anglers to use | 1 | 2 | 3 | 4 |
| f. | Unused live baitfish should not be thrown into a body of water other than the water where you caught them | 1 | 2 | 3 | 4 |

7. Organizations rely on a variety of activities to encourage *boaters and anglers* to adopt behaviors that will reduce the spread of aquatic invasive species. Which of the following activities do you use in your program? [*Check all that apply.*]

- Distributing print materials
- Maintaining web sites
- Maintaining Facebook pages
- Communicating through Twitter
- Developing smart phone apps
- Distributing refrigerator magnets
- Posting quick response (QR) codes directing individuals to information on the web

- Communicating through the mass media (newspapers, radio, television, etc.)
- Maintaining billboards
- Posting signs at boat launch sites or fishing access sites
- Making invasive species disposal stations available at boat launch sites or fishing access sites
- Making boat washing stations available for boaters to use
- Having “stewards” available to speak to watercraft users or anglers about best practices at marinas or access points
- Maintaining displays or exhibits demonstrating how to clean recreational equipment
- Conducting workshops or training sessions
- Making presentations to specific groups or the general public
- Staffing booths at community events or festivals
- Staffing booths at boat shows
- Maintaining hotlines to provide information about aquatic invasive species

8. What organization do you work for or represent in your work related to aquatic invasive species?

9. We are interested in the interactions between organizations doing work related to aquatic invasive species. During the past five years, how frequently have you interacted with individuals in each of the following organizations (including other individuals in your own organization) *in your work on aquatic invasive species*?

- 1=Never interacted
- 2=Rarely interacted (no more than once a year)
- 3=Sometimes interacted (several times a year)
- 4=Frequently interacted (at least once a month)
- 5=Very frequently interacted (at least once a week)

		Have you interacted with individuals in this organization...				
		Never?			Very frequently?	
a.	Adirondack Park Invasive Plant Program	1	2	3	4	5
b.	Audubon New York	1	2	3	4	5
c.	Cayuga County Water Quality Management Agency	1	2	3	4	5
d.	Cayuga Lake Watershed Network	1	2	3	4	5
e.	Central Lake Ontario Conservation Authority	1	2	3	4	5
f.	City of Ithaca	1	2	3	4	5
g.	Cornell Cooperative Extension, St. Lawrence County	1	2	3	4	5

h.	Cornell Cooperative Extension, Onondaga County	1	2	3	4	5
i.	Cornell Cooperative Extension, Tompkins County	1	2	3	4	5
j.	Cornell Cooperative Extension, Wayne County	1	2	3	4	5
k.	Cornell Cooperative Extension, Yates County	1	2	3	4	5
l.	Cornell Cooperative Extension (outside of county offices)	1	2	3	4	5
m.	Cornell Cooperative Extension Statewide Invasive Species Program	1	2	3	4	5
n.	Credit Valley Conservation	1	2	3	4	5
o.	Ecology and Environment	1	2	3	4	5
p.	Finger Lakes Institute	1	2	3	4	5
q.	Finger Lakes-Lake Ontario Watershed Protection Alliance	1	2	3	4	5
r.	Finger Lakes PRISM	1	2	3	4	5
s.	Floating Classroom	1	2	3	4	5
t.	Fort Drum	1	2	3	4	5
u.	Genesee Land Trust	1	2	3	4	5
v.	Lewis County Soil and Water Conservation District	1	2	3	4	5
w.	New York Sea Grant	1	2	3	4	5
x.	NYS Department of Environmental Conservation	1	2	3	4	5
y.	NYS Department of Transportation	1	2	3	4	5
z.	NYS Office of Parks, Recreation, and Historic Preservation	1	2	3	4	5
aa.	Ontario Federation of Anglers and Hunters	1	2	3	4	5
bb.	Ontario Ministry of Natural Resources	1	2	3	4	5
cc.	Ontario Streams	1	2	3	4	5
dd.	Oswego County Soil and Water Conservation District	1	2	3	4	5
ee.	Steuben County Soil and Water Conservation District	1	2	3	4	5
ff.	St. Lawrence-Eastern Lake Ontario PRISM	1	2	3	4	5
gg.	The Nature Conservancy	1	2	3	4	5
hh.	U.S. Fish and Wildlife Service	1	2	3	4	5
ii.	Western New York PRISM	1	2	3	4	5

10. During the past five years, how frequently have you used the New York Invasive Species Clearinghouse (NYIS.INFO) as a source of information *in your work on aquatic invasive species*?

- Never
- Rarely (no more than once a year)
- Sometimes (several times a year)
- Frequently (at least once a month)
- Very frequently (at least once a week)

Thank you for your time!