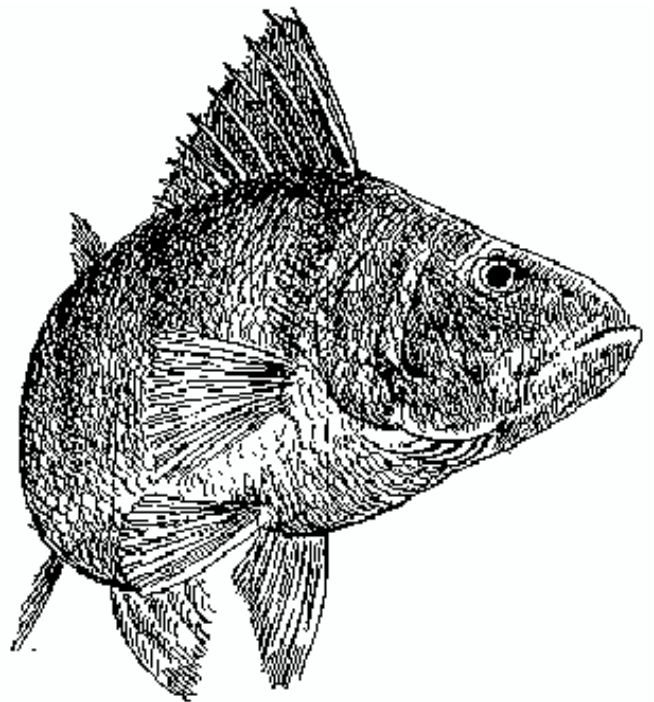


---

# **Human Responses to Viral Hemorrhagic Septicemia Virus in the Great Lakes**



**September 2009**

**HDRU Series No 09-10**

---

Prepared by:

T. Bruce Lauber, Nancy A. Connelly, and Barbara A. Knuth  
Human Dimensions Research Unit  
Department of Natural Resources  
Cornell University

## HUMAN DIMENSIONS RESEARCH UNIT PUBLICATIONS SERIES

---

This publication is part of a series of reports resulting from investigations dealing with public issues in the management of wildlife, fish, and other natural resources. The Human Dimensions Research Unit (HDRU) in the Department of Natural Resources at Cornell University studies the social and economic values of wildlife, fish, and other natural resources and the application of such information in management planning and policy. A list of HDRU publications may be obtained by writing to the Human Dimensions Research Unit, Department of Natural Resources, Fernow Hall, Cornell University, Ithaca, NY 14853, or by accessing our World Wide Web site at: <http://www.dnr.cornell.edu/hdru>.



This report is available electronically at: <http://www.dnr.cornell.edu/hdru/pubs/Elecpubs.asp>.

## **Acknowledgements**

The work described in this report was funded by the United States Department of Agriculture Animal and Plant Health Inspection Service.

## **Executive Summary**

The advent of new fish diseases is a critical concern of state and federal management agencies. First detected in the Great Lakes in 2005 (Lumsden et al. 2007), viral hemorrhagic septicemia virus (VHS) has spread rapidly in this system. VHS does not pose a risk to human health directly, but its presence and management have potentially negative impacts for human wellbeing, particularly for stakeholders with an economic dependence on fisheries or aquaculture. The spread and impacts of this disease are influenced by a complex array of social and ecological factors. This study was designed to improve understanding of how and why various stakeholder groups respond to VHS, and help inform future management and education actions.

This study provides insights about key stakeholder groups, including agency staff members, anglers, aquaculturists, and bait dealers, to help inform the design and implementation of VHS educational efforts by state and federal agencies. Our objectives were to:

- 1) Identify the range of knowledge, awareness, and concern regarding VHS among key stakeholder groups, including knowledge and awareness of VHS effects, risk-reducing behaviors, regulations, and agency educational efforts intended to manage detrimental effects.
- 2) Identify sources of information used by these stakeholder groups regarding VHS.
- 3) Characterize the range of willingness to respond to VHS and actual behavioral responses taken by these stakeholder groups.
- 4) Assess the degree to which stakeholder behavior is consistent with agency recommendations and identify key constraints on stakeholder compliance with these recommendations.
- 5) Compare sources and types of information, knowledge/awareness levels, and behaviors to identify which sources and messages appear to be associated most strongly with various (desired) responses.

We conducted: (1) a content analysis of educational materials focused on VHS-related regulations and behavioral recommendations from USDA-APHIS, state fish and wildlife agencies, and Sea Grants in the eight Great Lakes States; (2) semi-structured, open-ended interviews of 20 agency staff members who work on VHS in the eight Great Lakes states; and (3) semi-structured, open-ended interviews of 23 representatives of stakeholder organizations (angler organizations, aquaculture organizations, and bait dealers). Through a content analysis of interview transcripts, we characterized respondents' perceptions about VHS and its management.

Our results focused on the following topics:

- agency and stakeholder beliefs about the effects of VHS;
- beliefs about the spread of VHS;
- perspectives on regulations and recommendations to address VHS;
- factors influencing compliance with regulations and recommendations;
- changes in regulations that are deemed necessary; and
- information sources on which stakeholders rely.

Our principal findings include:

- Respondents were concerned about the potential effects of VHS on wild fish populations, recreational angling, hatcheries, and aquaculture. However, considerable uncertainty existed about how much of an impact VHS would ultimately have. In general, concerns have decreased as time has elapsed without dramatic noticeable impacts from VHS.
- Most respondents believed that VHS was here to stay in the Great Lakes system. The vectors that were most frequently perceived to contribute to its spread were the natural movement of fish, the actions of recreational anglers (e.g., bait transfer between waters, boat movements), and ballast water.
- APHIS' initial emergency order stopping the interstate movement of fish was perceived as having a severe negative impact initially on the aquaculture industry. After APHIS amended this order, most respondents viewed it as tolerable. Based on comments from a range of stakeholders and agency staff, the requirements of the indefinitely delayed interim rule were perceived as being excessive.
- The impacts of regulations on bait dealers have been similar to those on aquaculture operations. However, regulations on harvest are more relevant to bait dealers. These regulations have varied from state to state, and these differences have caused additional difficulties.
- Many anglers believe that VHS regulations have resulted in a lower availability of bait – in particular, lower availability of certain species. A number of respondents argued that this condition has discouraged fishing and had negative consequences on communities that are economically dependent on fishing.
- Compliance with VHS regulations and recommendations was perceived to be: (1) fairly low among anglers; (2) inconsistent among bait dealers (with the perceptions of some that wild bait dealers were least likely to comply); and (3) high among aquaculture operations.
- In cases in which compliance was inadequate, the factors found most likely to limit compliance included: (1) low awareness of or concern about VHS; (2) high costs of compliance; (3) perceptions that compliance was infeasible; (4) a perceived low level of enforcement of regulations; (5) the perception that regulations would not be effective at limiting the spread of VHS; and (6) perceptions that the regulations or the process used to develop the regulations were unfair.
- The most frequently perceived needs in VHS regulations included: (1) greater coordination and consistency at both the state and the federal level; (2) making regulations correspond to watershed boundaries rather than political boundaries; and (3) framing VHS regulations within the broader context of efforts to control the spread of invasive species.

With regard to information sources about VHS, our key findings included:

- Our pool of interview respondents relied much more on expert sources of information (APHIS, state fish and wildlife agencies, state agriculture agencies, Sea Grants, industry associations, angler organizations, and researchers) than popular sources (newspapers and magazines).

- Respondents actively sought information both from individual contacts with these organizations and from the web sites these organizations maintained.
- The sources of information and the number of sources of information differed for different groups of respondents. Sea Grant staff members relied on the greatest number of information sources and were particularly likely to rely on primary sources of information about VHS regulations and research.
- State fish and wildlife agencies relied on the next greatest number of information sources. The two most common sources of information for fish and wildlife agencies, however, were other state fish and wildlife agencies and the Great Lakes Fishery Commission, which is closely affiliated with state fish and wildlife agencies.
- Representatives of key stakeholder groups relied on fewer sources of information on average than agency and Sea Grant staff members. State fish and wildlife agencies were a particularly important source of information for these stakeholder groups, with more than 50% of the members of each group that we interviewed relying on these agencies for information.

In addition to the data we collected on factors influencing compliance, many respondents also discussed changes in the management of VHS that they believed were necessary. Virtually all assumed that the management of VHS through regulations and education would continue to evolve, and many argued for greater coordination and cooperation between agencies during this process. Because it is widely believed that interactions between key agencies involved in efforts to manage VHS are characterized by poor relationships, lack of trust, and inadequate communication our results support this contention.

## Table of Contents

Acknowledgements .....	i
Executive Summary .....	ii
Table of Contents .....	v
List of Tables .....	vi
Background .....	1
Theoretical Foundation .....	3
Theory of Planned Behavior .....	3
Procedural Fairness .....	3
Methods .....	4
Content Analysis of Educational Materials .....	4
Agency Interviews .....	4
Stakeholder Interviews .....	5
Content Analysis of Interviews .....	5
Social Network Analysis Methods .....	5
Results .....	6
Effects of VHS .....	6
Wild Fish Populations .....	6
Hatcheries and Aquaculture .....	11
Spread of VHS .....	13
Regulations and Recommendations .....	15
Federal and State Regulations .....	15
Effects of Regulations on Stakeholders .....	18
Compliance .....	25
Factors Influencing Compliance .....	28
Awareness and Concern .....	29
Costs and Benefits of Compliance .....	31
Feasibility of Compliance .....	32
Enforcement .....	34
Adequacy of Regulations .....	35
Fairness .....	38
Necessary Changes .....	46
Information Sources .....	49
Conclusions .....	56
Literature Cited .....	59

## **List of Tables**

Key messages in state fish and wildlife agency and APHIS VHS communication.....	16
Key messages in state Sea Grant VHS communication.....	17
Characteristics of interview respondents included in information source analysis .....	50
Percentage of respondents using various sources of information about VHS .....	51
Percentage of respondents using various sources of information about VHS, by stakeholder group .....	54
Mean closeness values, by stakeholder group .....	55

## **Background**

The advent of new fish diseases is a critical concern of state and federal management agencies. First detected in the Great Lakes in 2005 (Lumsden et al. 2007), viral hemorrhagic septicemia virus (VHS) has spread rapidly in this system. VHS does not pose a risk to human health directly, but its presence and management have potentially negative impacts for human wellbeing, particularly for stakeholders with an economic dependence on fisheries and aquaculture. The spread and impacts of this disease are influenced by a complex array of social and ecological factors. This study was designed to improve understanding of how and why various stakeholder groups respond to VHS, and help inform future management and education actions.

VHS has resulted in local, state, and federal concerns and responses. Education programs and regulatory actions have been instituted to influence human behaviors related to fish culture, handling, preparation, harvest, and selling. The U.S. Department of Agriculture Animal and Plant Health Inspection Service (USDA-APHIS) issued a federal order in 2006 in response to the rapid spread of VHS in the Great Lakes region; that order was later modified. In September 2008, USDA-APHIS announced an interim rule, which has since been indefinitely postponed. These regulations are intended to curtail the movement of potentially infected fish, and thus the spread of VHS. They strictly regulate the importation of live fish of VHS-susceptible species from Ontario or Quebec as well as the interstate movement of live fish of the same species within the eight states bordering the Great Lakes. Movement of these species requires documentation, appropriate facilities, and/or testing for VHS.

Most of the state fish and wildlife management agencies in the eight Great Lakes states have issued regulations intended to limit the spread of fish diseases (including VHS) through the movement of infected fish between bodies of water. These regulations specify conditions under which the sale, use, and transport of fish can occur. Beyond a regulatory approach, educational efforts are underway by both state agencies and various other organizations to alert anglers and others to the role they can play in limiting the spread of VHS and other diseases.

The presence of this pathogen in Great Lakes waters, and the associated information campaigns and regulatory controls that have been instituted, has the potential to affect the activities and livelihoods of multiple Great Lakes stakeholders, including recreational anglers, aquaculture operations, bait dealers, communities depending on fisheries-based tourism, and resource managers at state, federal, and international levels. For example, anecdotal reports throughout the Great Lakes suggests some bait dealers have been driven out of business or have had to adopt other products for sale to stay in business.

Understanding the responses of different stakeholder groups to the discovery and management of VHS in the Great Lakes will help determine the prospects for success of various management approaches. The goal of this research was to determine whether stakeholders adopt the behaviors advocated through information campaigns, including compliance with regulations, and why certain behaviors are more or less likely to be adopted.

Conventional models of compliance with fisheries regulations have focused on the economic costs and benefits of violations (e.g., Anderson and Lee 1986). More recently, authors have pointed to the need to include additional considerations, such as values, social influences, and the legitimacy of regulations and authorities, in explanations of compliance (Sutinen and Kuperman 1999, Hatcher et al. 2000).

This study provides insights about key stakeholder groups, including agency staff members, anglers, aquaculturists, and bait dealers, to help inform the design and implementation of VHS educational efforts by state and federal agencies. Our objectives were to:

- 1) Identify the range of knowledge, awareness, and concern regarding VHS among key stakeholder groups, including knowledge and awareness of VHS effects, risk-reducing behaviors, regulations, and agency educational efforts intended to manage detrimental effects.
- 2) Identify sources of information used by these stakeholder groups regarding VHS.
- 3) Characterize the range of willingness to respond to VHS and actual behavioral responses taken by these stakeholder groups.
- 4) Assess the degree to which stakeholder behavior is consistent with agency recommendations and identify key constraints on stakeholder compliance with these recommendations.
- 5) Compare sources and types of information, knowledge/awareness levels, and behaviors to identify which sources and messages appear to be associated most strongly with various (desired) responses.

This study was exploratory. Our analyses relied on qualitative data collected primarily through in-depth, semi-structured interviews. Such analyses are useful for developing detailed descriptions of stakeholders' perspectives and are particularly appropriate in contexts in which the full range of perspectives can not be anticipated in advance. Consequently, we used these analyses to characterize the range of perspectives among key informants in selected stakeholder groups across the Great Lakes region. These data and analyses, however, are not suitable for producing a quantitative, statistical portrait of representative samples of selected stakeholder groups. A second phase effort could be designed to provide such a quantitative characterization using standardized surveys with questions informed by the results of this study.

The remainder of this report is organized into four primary sections:

- a description of the social science theory that informed the design of our questions to assess possible factors influencing compliance with regulations and recommendations;
- a description of our research methods;
- the presentation of our results, which primarily portray respondents' perspectives in their own words through interview excerpts; and
- our conclusions, in which we assess the implications of our findings for efforts to increase compliance with VHS regulations and recommendations.

## **Theoretical Foundation**

We drew from two theoretical frameworks to help structure our efforts to understand stakeholder responses to VHS-related fisheries risks and associated management regulations and recommendations: The Theory of Planned Behavior and Procedural Fairness.

### **Theory of Planned Behavior**

The Theory of Planned Behavior (Ajzen 1989) identifies the types of factors that influence behavior. It has been used to explain compliance with regulations and recommendations in a wide variety of contexts, including complying with traffic regulations (Elliott et al. 2003), following health recommendations (O'Boyle et al. 2001), and obeying tax laws (Bolek and Hatfield 2003). Knuth et al. (1993) applied the Theory of Planned Behavior specifically to understand whether anglers complied with the recommendations of fish consumption health advisories.

In this study, we used the Theory of Planned Behavior to identify factors that influence whether stakeholders' behavior is in compliance with the requirements of regulations or the recommendations of information campaigns related to VHS. The Theory of Planned Behavior postulates that these behaviors are influenced by three interrelated factors: (1) "attitude toward the behavior" (Does an individual think engaging in the behavior is good or bad? For example, do anglers think it is important to disinfect their live wells and bait wells before using their vessel on another body of water?); (2) "perceived behavioral control" (How easy or difficult do individuals think the behavior is? For example, do anglers perceive it is easy for them to disinfect their live wells and bait wells?); and (3) "subjective norm" (What social pressures exist for individuals to engage in the behavior? Do anglers' peers or other important referent groups think it is important to disinfect live wells and bait wells?). Each of these factors is, in turn, affected by other beliefs and attitudes.

Consequently, we measured the following variables to determine what factors might influence stakeholders' behavior in relation to compliance with the requirements of regulations related to VHS or the recommendations of information campaigns related to VHS:

- Awareness of the presence of VHS;
- Beliefs about the effects of VHS;
- Beliefs about how VHS spreads;
- Beliefs about and understanding of regulations and recommendations;
- Concern about VHS and its effects;
- Stakeholder affiliation and perceived relevance of the diseases to peer groups; and
- Constraints (money, time, and expertise).

### **Procedural Fairness**

The Theory of Planned Behavior postulates that attitudes toward complying with regulations will influence whether or not people actually comply with them. These attitudes, in turn, are

considered to be determined by the *outcomes* of complying with the regulations – whether these outcomes will be desirable or undesirable.

A large body of research on the social psychology of procedural fairness, however, demonstrates that attitudes toward management decisions are influenced not just by the perceived *outcomes* of those decisions, but by perceptions of the *processes* by which the decisions were made. If a decision-making process is considered fair, stakeholders are more likely to accept the decision produced, even if it does not satisfy their own personal interests (Lind and Tyler 1988, Lauber and Knuth 1997;1999, Smith and McDonough 2001, McComas et al. 2007). Therefore, we anticipated that compliance with regulations would be influenced not just by the expected outcomes of compliance but by perceptions of the process used to develop those regulations.

The primary factors that have been shown to influence the perceived fairness of decision-making processes are concerned with how affected interests are considered. These factors include whether: affected stakeholders are adequately represented in the process; stakeholders have the opportunity to express their opinions; decision makers are willing to consider their input; stakeholders' input influences the decision; and decision makers are perceived as knowledgeable (Lauber and Knuth 1997;1999, Tuler and Webler 1999, Smith and McDonough 2001).

We explored the influence of perceptions of the decision-making process associated with VHS regulations on attitudes toward these regulations because: (1) these perceptions have been found to influence attitudes toward management decisions in past studies; and (2) communication about decision-making procedures is a possible strategy for building support for regulations in the future.

## **Methods**

### **Content Analysis of Educational Materials**

We conducted a content analysis of educational materials focused on VHS-related regulations and behavioral recommendations from USDA-APHIS, state fish and wildlife agencies, and Sea Grants in the eight Great Lakes States to identify: (1) key pieces of knowledge about VHS that should be accessible to stakeholders if they are exposed to these sources; and (2) desired stakeholder behaviors in relation to VHS. For each agency or organization, we attempted to identify the most comprehensive available web site focused on education about VHS, and analyzed the content of that web site.

### **Agency Interviews**

We conducted semi-structured, open-ended interviews of 20 agency staff members who work on VHS in the eight Great Lakes states. We identified interview respondents primarily from within state fish and wildlife agencies and Sea Grants, but also included respondents from USDA-APHIS and state agriculture agencies. Our interviews focused on: (1) key messages agencies try to communicate about the effects and transmission of VHS and about regulations and recommendations to address VHS; (2) behavioral responses they hope to see (and hope not to see) among anglers, aquaculturists, and bait dealers; (3) constraints they anticipate may affect

stakeholders' compliance with regulations and recommendations; (4) concerns they have about the presence of VHS; and (5) information sources on which they rely.

### **Stakeholder Interviews**

We conducted semi-structured, open-ended interviews of 23 representatives of stakeholder organizations. We selected representatives of angler organizations, aquaculture organizations, and bait dealers in each of the Great Lakes states. Respondents were interviewed both about their own perceptions and behaviors related to VHS as well as the perceptions and behaviors of other members of their stakeholder groups. Our interview questions focused on: (1) awareness and knowledge of the effects and transmission of VHS and of the regulations and recommendations to address VHS; (2) sources used to gain information about VHS; (3) behavioral responses to the presence of VHS and willingness to take steps to help mitigate VHS; (4) awareness and perceptions of agency messages about VHS; (5) perceived constraints on compliance with management regulations and recommendations; and (6) concerns about the presence of VHS.

### **Content Analysis of Interviews**

When we received respondents' permission, we recorded and transcribed interviews. We conducted a content analysis of interview transcripts in which we characterized each stakeholder group according to the content areas outlined above in the descriptions of agency and stakeholder interviews. We compared: (1) different stakeholder groups; and (2) stakeholders with agency staff members.

This type of qualitative data analysis is suitable for characterizing the perspectives of populations of interest in detail. Results are primarily presented in the form of interview excerpts, and these excerpts were selected to reflect the range of perspectives with regard to particular topics related to VHS. However, given that these results are based on small, purposefully selected samples, they can not be used to draw inferences about the frequency with which various perspectives are held among stakeholder populations in general.

### **Social Network Analysis Methods**

We also analyzed the data respondents provided on their information sources using social network analysis methods. Social network analysis includes a variety of methods that allow analysis of relationships. Characteristics of the networks that may influence individuals within it include how many sources of information each individual receives information from and which sources they receive information from.

We also used Ucinet 6 for Windows to calculate "closeness," a measure of how central individuals were in the network based on their information sources. We considered the use of a common information source by two individuals as establishing a relationship or linkage between them; it is an indication that they are exposed to similar information. Closeness quantifies how closely connected an actor is with other actors in the network overall. Once we documented relationships between actors based on common information sources, we were able to calculate

the “distance” that separates each pair. Some pairs of actors are directly related to each other. Others may be related only indirectly through a third actor. Still others may require two or more other actors to connect them. The “geodesic” for a pair of actors is the shortest path necessary to connect them. For every actor in a given network, we can calculate “farness,” which is the sum of its geodesics with every other actor in the network. If we take the inverse of farness, we get the actor’s “closeness,” which essentially indicates how easily it can reach every other actor in the network. Because closeness is dependent on the size of a network, it is typically normalized by dividing an actor’s closeness by the maximum possible closeness for that network. It is expressed as a percentage varying from 0 to 100. In this context, high closeness values indicate that an individual operates in an information environment that is very similar to those of others within the network.

## **Results**

Because different stakeholder groups had considerable overlap in their perspectives on VHS, we organized our results by topic rather than by type of stakeholder. Our results are divided into six sections focusing on the following topics:

- agency and stakeholder beliefs about the effects of VHS;
- beliefs about the spread of VHS;
- perspectives on regulations and recommendations to address VHS;
- factors influencing compliance with regulations and recommendations;
- changes in regulations that are deemed necessary; and
- information sources on which stakeholders rely.

Each interview excerpt presented is labeled with a code that identifies the interview from which it was drawn (e.g., A-AG-1) and a particular stakeholder group, such as “state fish and wildlife agency” (including the Great Lakes Fishery Commission, which is allied with state agencies), “state agriculture agency,” “APHIS,” “aquaculture,” “bait dealer,” etc.

### **Effects of VHS**

Agency and stakeholder beliefs about the effects of VHS can be divided into:

- beliefs about VHS effects on wild fish populations (and the associated fisheries); and
- beliefs about VHS effects on hatcheries and aquaculture.

#### **Wild Fish Populations**

One set of concerns about VHS related to the impacts it could have on wild fish populations. These concerns were expressed most frequently by staff members of natural resource management agencies:

*I think the key concerns are that it gets into particular populations and causes population effects. (A-AG-8, state fish and wildlife agency)*

*You have to understand I have a population of ... brook trout that number 500 to 600 individuals and ...is the brood population for restoration efforts on the U.S. side of Lake Superior Basin. ... So that and the fact that I have a mostly intact lake trout fisheries. ...So that fishery resource ... is very critical. (A-G-13, federal resource management agency)*

Concerns about wild populations were closely related to concerns about recreational fishing and the economic benefits it provides:

*The threat ... to the social aspects of fishing and the sustainability of ... the fishing culture that is important ... not only from the tourism perspective but from an historical/cultural perspective... (A-AG-15, Sea Grant)*

*If that disease is in a small inland lake, it could wipe a small fishery out in a small lake... As far as being in the fishing business for a living also, if it did wipe a species out... I have a concern it would affect my livelihood also. As an angler, I work in one of the largest bait and tackle stores in the northeastern United States and I run a charter boat that provides income for me. (A-S-3, angler/bait dealer/charter boat)*

*Well, I am worried about the impact it's going to have in the state. I am worried about the impact it will have if it shows up within the state. I am worried about the perception for tourism because if people think we have diseased fish here in the state, that is going to drop our tourism exponentially, and that is a bad thing. (A-S-4, wild bait/aquaculture)*

*The worst case example is played out in devastation to recreational fishing, to commercial fishing, to the related economy. You know ... recreation is the second biggest economic engine in this state... This state sells enormous numbers of fishing licenses, boating - I mean the tentacles and the economic impact and biological could be enormous. (A-S-6, angler)*

However, many interview respondents, particularly those with Sea Grant or state fish and wildlife agencies, expressed uncertainty about the magnitude of the effects that VHS would ultimately have on wild fish populations:

*Are we looking at the long term changes in the fish populations or are we going to ... see dramatic die offs at first and then the populations will rebound? (A-AG-15, Sea Grant)*

*What is the long term impact of the virus? Will it keep as a typical virus goes showing up here or there or random occurrences? Or will we see major impacts to important recreational fish populations? I don't have a complete knowledge. (A-AG-2, state fish and wildlife agency)*

*Scientists believe the Great Lakes virus was a mutated strain of the marine virus. Is there a potential for a future mutation of a virus which could affect other fish species and then eventually affect human health? (A-AG-11, Sea Grant)*

Several respondents pointed out that it was important to distinguish fish kills from population-level impacts on fish populations. They suggested that fish kills could be dramatic and visible, but might not be indicative of a problem:

*The first concern I have is does VHS affect fish populations? When I say that, I mean does it have population level impact? I know that is a very different thing than seeing tens of thousands or hundreds of thousands of fish wash up dead on the beach. Because sometimes having that level of mortality doesn't necessarily mean there is a population impact. (A-AG-5, state fish and wildlife agency)*

*We had this big muskie kill on Lake St. Clair. It was really nasty looking... On a population basis, how much of our muskie population did we lose on St. Clair?... Population basis about one tenth of one percent of the Lake St. Clair population... On a population basis we are not seeing the major impact from this virus that has been predicted. (A-S-13, aquaculture)*

Overall, the widespread perception of VHS among both state fish and wildlife management agencies and affected stakeholder groups is that it is not as likely to have a substantial effect on wild fish populations as was once feared:

*I have to say first that my concerns are ...not as high ...as catastrophic. I mean it is going to ... cause mortalities... Some of the species could have population effects, particularly muskies. I am not as concerned about it ... being an historical event that it is going to go through and destroy all of our fish because it is highly unlikely based on what we know now. (A-AG-8, state fish and wildlife agency)*

*We are not concerned about the disease on wild fish population. It is a wild fish disease. We've had wild fish diseases come through and then the next disease comes in and we forget about the last one. (A-AG-1, state fish and wildlife agency)*

*What is the reality of VHS so far? Basically, it is a wet firecracker. We have not seen nearly the mortality that would have been expected given the terrible scenario that was painted about this disease in 2006. I mean it was being pitched as the end of fish life as we know it today because it would affect a broad range of fish species that we would have tremendous die offs, blah, blah, blah, blah, blah. You know in 2008 was a big fizzle. Where were the big fish kills?... You know there were a couple minor fish kills that were attributed to VHS because they could detect VHS in the fish. They never really established that the fish died of VHS... The fish kills happen on the Great Lakes and they have always. Different species, different years, different times, different places. There have always been fish kills. (A-S-13, aquaculture)*

*It is not the end of the world ... Yes, it is a very serious threat to our fishery, but we can take these steps and even if it does get in our lakes, it is not going to kill everything out there. (A-AG-15, Sea Grant)*

*It seems like it only wants to stay in certain areas - big waters, cold waters. I guess it would spread. I haven't seen nothing. As much as I have read up on it and look into it I haven't seen nothing. No major fish kills. No nothing. They are saying there was but we as a people have never seen and they never proved it. When it got in the Winnebago system it seems like it was a really big deal and the state was going to shut right down. And it just about did and only ones that died were the sheephead... and they have been dying like that for 50 years by that dam. You know every spring it is like that. (A-S-2, wild bait)*

One reason for this cautious optimism is the amount of time that has elapsed without dramatic impacts of VHS on wild fish populations. As more time has elapsed, many interview respondents have become less concerned about VHS:

*When they first got in it, it seemed to be doing a lot of damage in the lower lakes ... So we just sat back helplessly waiting for the spread...However, things haven't been so bad after all. So our initial reaction was gloom and doom and frustration and anger. Maybe we are getting a bit of a reprieve, at least in the wild ... We kind of see VHS as becoming another source of background mortality, which is not good. But it doesn't appear to be the "boogie man" that it seemed to when it first hit. It has had plenty of time now to cause more mass mortalities and it doesn't seem to have done that in any of the places we have been. (A-AG-6, tribe)*

*I think that we are probably seeing a stabilization of the virus somewhat meaning that the virus is in the lake and the fish have been exposed and we have had some die offs and it appears to me that surviving parts of the population, which is the vast majority of them, might ... have some immunity. Because we are not seeing any other outbreaks ... So I am not really concerned that we are not going to see great changes in wild fish stocks. (A-AG-16, Sea Grant)*

*It is a concern just knowing that it can affect other fish but it hasn't shown up quite like we thought it would. (A-AG-3, state fish and wildlife agency)*

In addition, some stakeholders indicated that they have begun to question some of the evidence of VHS. One argued that reported fish kills have been exaggerated:

*I was really disappointed because there was a lot of false information that was reported. You know as far as the wind rows of fish that died and things of that nature - never happened... One of the large fish kills - my brother happened to live right on that shore of Lake Erie and he went down and took pictures and we had like a fish every square yard that had washed up on the beach opposed to ... that we had killed miles long - 300 yards off shore and fish stacked 20 feet deep. ...So, you know a lot of disenchantment with those of us who actually have our finger on the real pulse of the animal because we see a lot of questionable reporting. (A-S-19, aquaculture)*

Several posited other explanations for those fish kills that have occurred:

*The only time we see a fish kill is when a trap netter ... we've had straight days of strong north wind... They don't go out and run those traps ... When they do, the fish are all dead. So what are you supposed to do with them? They roll the net over and dump them out. And you have got tens of thousands sometimes of dead fish. I have seen the time in the 70's when I commercial fished on the shores of Lake Erie we would ...pull in 35 ton of sheephead. That's a lot of fish. And if you can just imagine in your mind and envision a net ... with that many fish in it and when you get them in you don't know what you've got until you get them in. You want to see a panic because we didn't want 35 ton of dead fish on the shore so we are trying to get those nets open and out and lots of times it doesn't happen. You might kill 10 or 15 ton of fish before you get the net open and that is a lot of fish to float up and down the shore. Traditionally, it has happened forever. (A-S-18, aquaculture)*

Some expressed uncertainty as to why the impacts of VHS had not been as great as was feared:

*We thought it was going to spread like wildfire ... and it hasn't done that... If you really like to say it is because of prevention efforts... I am not so sure that is the only fact. So I would like to get a little better understanding what is really going on. (A-AG-15, Sea Grant)*

A number of others posited possible explanations for minimal impacts, including that: (1) wild stocks had developed an immunity to VHS;

*I think slowly the documentation surfacing here that this virus has been around for a minimum of one or if not two decades. The resistance has obviously been built by the wild stock because we are not seeing the fish kills. (A-S-18, aquaculture)*

(2) the variant of the virus in the Great Lakes might not be as deadly as other variants;

*This is 4B, the strain in the Great Lakes. They identified it as a separate strain... The strain that is in Europe, for instance, is very deadly to rainbow trout and it has done a lot of harm to their industry... The industry over there has gone to the government. Help us? How can you help us? What can we do? And they worked and worked and they are still fighting the problem over there. But that particular strain is very deadly to rainbow trout. This strain, we don't know for sure if it will kill the rainbow trout if you give it all it can get of this strain of VHS... And this strain affects other species that that strain doesn't affect. And this strain affects a wide range of species, but trout it does not seem to affect to any great extent. So it is different. It is a different strain and it is affecting fish differently and everybody is still learning about just exactly how this strain is acting. (A-S-18, aquaculture)*

*But it is a virus that is reacting just like every other virus has in nature...It mutated, we think, but we don't know when it mutated. Obviously, it mutated at least a decade ago because they keep going back and finding frozen samples...Here we sit in 2009 now on a virus that was around probably without a question when I was a boy commercial fishing...It has been there for a long time. Unfortunately, somebody did not do their*

*homework before they issued the emergency order and I am not throwing blame at anybody I am trying to tell it like I see it and how a lot of other people see it...From this point on, why should we treat this virus any different than we do every other virus that is out there?... Every article you read calls this thing the world's most deadly fish virus. Wait a minute, the original version of this - the salmonid version that came from Europe was the most deadly... This happens to be a mutation...So why don't we deal with it as well here only as a mutated strain. Let's get on with it. (A-S-19, aquaculture)*

and (3) warmer than usual lake waters have delayed spread of disease to this point.

*Since then, I don't think we have seen a big fish kill. But my understanding is, we had a somewhat mild winter last year, and my understanding of this virus is that it works differently than most others would work. When there is warmer water it seems not to be as affected as in cold water. That's what they tell us - that the cold water in Buffalo is why it is so rampant down there because Lake Erie stays very cold. Now, this year could be a real good sign to see if this thing breaks out. Because we have got 18 inches of ice on the Lake and we have had an extremely cold winter... So, if it is going to break out in force, I think we will see some signs of it this year. (A-S-10, bait dealer)*

### **Hatcheries and Aquaculture**

In addition to concerns about the effects of VHS on wild fish populations, numerous stakeholders spoke to the effects it could have on hatcheries and aquaculture operations. Many of the respondents who were in the business of raising fish had strong concerns about its potential impact.

*It starts actually well before APHIS took any action. About two years before APHIS did anything, I had seen reports of VHS coming out of New York State in the popular press and stuff online about VHS moving inland and being in Lake Ontario and being connected to the Great Lakes, and that raised some flags for me. And so, even two maybe three years before APHIS took any action, when it first started appearing I started sending emails to regulatory authorities in Michigan ...This disease is certainly one ...concern. We have seen big problems with it in Europe, what is the plan? (A-S-13, aquaculture)*

*We also wanted to minimize any risk of bringing the disease into our facility... If we were to show up positive, to be honest, I am scared of bringing it in from our side of things. Everything was tested. Believe me the first three rounds of testing, I was nervous. I am still nervous when we send fish in for health testing. (A-S-7, bait dealer/aquaculture)*

*The aquaculture industry that I deal with - I mean that's a big concern there ... When you've got fish stock at the density ... if we would get VHS in the private sector, it would probably be a lot worse there just because of the density. That would probably wipe those completely out. The wild wouldn't be as bad, I wouldn't think. (A-S-17, aquaculture)*

Individuals representing both state fish and wildlife agencies and private producers thought it likely that the introduction of VHS into a facility could result in it being shut down:

*I think our number one concern is that we want to keep it out of our hatcheries...It would be devastating if it got into our steelhead production program. That would shut down our entire steelhead program which is extremely popular. It is very important with respect to recreational use and just economically in the whole northwest part of the state. (A-AG-12, state fish agency)*

*My biggest concern would be for it somehow to be transferred into a commercial operation. That would definitely be devastating for an individual. If they were to get an outbreak it most assuredly would shut them down...It would be very difficult for a commercial operation facility to survive something like that. (A-S-9, aquaculture)*

Another state fisheries manager thought the introduction of VHS into a hatchery would cause problems, but that those problems would not be insurmountable:

*If it would show up in one of our hatcheries or ponds, it would create a lot of headaches for us. I don't think they are insurmountable...We have to ensure that our agency is not a propagator of the disease across the landscape which we certainly don't want our efforts to be the cause of VHS showing up everywhere. (A-AG-8, state fish and wildlife agency)*

But many private aquaculture operations were not overly concerned about VHS. Some thought that given their location, the introduction of VHS was unlikely:

*You know we are probably 300 miles from Lake Erie. Pennsylvania has 75 or 95 miles of shore line. It has never been found in Pennsylvania and I don't know that it has been found on any of the shore lines of Lake Erie or Pennsylvania borders. Maybe I am naïve but at this point ... Most certainly I'm not going to go to western Pennsylvania into Lake Erie water drainage and buy any fish and whatever and bring them back to my facility. That's for darn sure. That will never happen. So, really, until it starts to maybe spread out and they find it in the watershed downstream from Lake Erie, or if they would find it in one of the watersheds more east in Pennsylvania... Like I said, maybe I'm naïve, but I just am not overly concerned about it... The biggest control I have is to staying out of those areas and ...I won't be hauling any fish in from an area where it could possibly be. (A-S-14, aquaculture)*

Others were much more concerned about the VHS regulations than VHS itself:

*You get back to just VHS - no one wants it - no farmer wants it. But the industry ... they are cautiously optimistic that it hasn't been found in any farm... There is a concern and there is a heightened level of understanding of the seriousness of trying to develop good farm biosecurity plans. That doesn't scare the farmers so much. What scares them and really has them upset and fighting for their livelihoods and losing their livelihoods in a lot of cases, are the regulations - not the fact that VHS is in the Great Lakes. VHS hasn't*

*put any farm out of business in this country but the regulations already have. (A-S-18, aquaculture)*

## **Spread of VHS**

Our interview respondents also discussed their beliefs about the spread of VHS in the Great Lakes system (and beyond). Most respondents clearly believed that VHS was now a permanent part of the system:

*Sometimes these things cannot be fixed. There is no way to turn back the key and there is no silver bullet for these things. (A-AG-4, state fish and wildlife agency)*

The potential for VHS to spread in the system both in the wild and into aquaculture operations was a cause of concern:

*We have many concerns about VHS. We have concerns about the movement and the spread in the wild... Part of the concern is that continued spread westward... And a concern is also the movement or potential movement of VHS from the wild to fish farms. The concern is the potential movement of VHS through wild harvest of fish - either by wild bait harvesters or by the resource agencies... Our concerns are with the impact of this disease in this region and on how people fish, how people raise fish, how people view fish health. (A-AG-20, state agriculture agency)*

*Our concern right now is how do we deal with trying to manage for the potential of introduction of VHS in our state and what type of production and commercial activities do we need to monitor to evaluate and regulate to either prevent it from entering ... or spreading around to some of our key recreational lakes and rivers in the state. (A-AG-2, state fish and wildlife agency)*

*My authority is for aquaculture facilities ... We want to keep it from spreading in the wild because many aquaculture facilities use ... open water sources and that those water sources become infected with the pathogen and then get the virus that way. So, I am concerned both for preventing it from coming into an aquaculture facility and also preventing it from spreading into the wild because if it spread in the wild, it will then affect aquaculture facilities. (A-AG-18, APHIS)*

*Controlling the spread of VHS ...but we also want to do that without a huge burden on the aquaculture industry. And that is one of the main concerns, but also spreading into the inland lakes. (A-AG-11, Sea Grant)*

A variety of reasons for the anticipated spread of VHS was offered. Some expressed the opinion that once the virus was in the system, it would spread because of natural processes, over which people had very little control:

*With invasive critters of any sort ... once the invasion is in the system, it is going to spread. Despite our best efforts, it is going to spread naturally or unwittingly. Even with*

*education, things are going to move and jump around. (A-AG-5, state fish and wildlife agency)*

*I want to stop it but there is no way of stopping it and that is the futile part of it. How with these regulations are you going to stop ... like I said before, you cannot stop a bird from going in and eating the minnows and then flying to another lake or creek or pond or whatever and spreading this stuff... Mother Nature is the only one that is going to stop this ...stop it totally. Mother Nature just takes over itself ... These fish and these minnows become resistant to the disease and they learn to break through it. (A-S-8, angler)*

However, some respondents expressed the opinion that the spread could be slowed through management efforts:

*If it is not for humans doing anything to move it, I don't think it is going to move very fast, which means it is a manageable problem. It is when it pops up across the landscape that it becomes very unmanageable and then you got problems popping up everywhere and you don't have solutions to deal with it necessarily. (A-AG-8, state fish and wildlife agency)*

In terms of human contributions to the spread of VHS, one of the two most frequently mentioned causes was anglers.

*Probably the most likely vector is live fish whether it is knowingly or unknowingly - whether they are moving game fish or just ...bait...If they are taking minnows that have been exposed to VHS from another lake that has VHS. (A-AG-3, state fish and wildlife agency)*

*Fishermen for sure, going into the Great Lakes with their boats, coming out and having some ... water or whatever and it's not properly drained and disinfected ...come back and put their boat into a lake downstate or whatever. I think that is probably going to be your biggest spreader of it ... if it ever does happen. (A-S-14, aquaculture)*

*In fact most of the people don't know what VHS is or know anything about it yet... I do think the fishermen need to be educated because I think the chance of transport by fisherman is greater than it is going to be in our aquaculture industry or the bait industry. I think that is something that really needs to be addressed at the federal and at the state level because I know you have people that fish the Great Lakes and then are going to end up ... pulling their boat out of Lake Michigan and bringing it here and whether they bring minnows with them because it is convenient or whether they have ... the chance of VHS being transported in a ... boat... Nature has a way of overcoming all obstacles. (A-S-4, wild bait/aquaculture)*

*I think it is emerging with anglers that they are becoming aware that their equipment, clothing - not just with VHS but their vehicles, boats ... causes it to be an agent for spread. I think anglers are increasingly aware of it...The fishing and angling and*

*hunting ... public is always suspicious of government regs and there is always a trust/credibility issue, but there is a growing awareness that we are part of the problem. (A-S-6, angler)*

The other frequently mentioned vector that could contribute to the spread of VHS was ballast water:

*If the ballast water is the culprit – and it may or may not be but it sure looks like it. (tribe, A-AG-6)*

*I wanted to make sure there was no ballast water exchange ... that could cause damage from VHS. (A-AG-13, federal resource management agency)*

## **Regulations and Recommendations**

Both state and federal agencies as well as the state Sea Grants have attempted to address VHS through a combination of regulation and education. Given the complexity of the regulations and the differences between states and between state and federal agencies, a comprehensive evaluation of the requirements of these regulations was beyond the scope of this project. Instead, we focused on assessing affected stakeholders' understanding of the requirements imposed by these regulations and their reaction to these requirements.

We did, however, compare key messages included in educational materials prepared by state fish and wildlife agencies, APHIS, and the state Sea Grants (Tables 1 and 2). Key messages of government agencies tended to emphasize the ecological and social consequences of VHS, species affected, locations where it has been found, how people contribute to its spread, and recommended and required human behaviors (which varied between agencies). Ohio provided fewer types of information than the other states and APHIS. The Sea Grants messages emphasized the ecological consequences of VHS, how it could be recognized, species affected, and recommended and required human behaviors (which again varied from state to state).

The remainder of this section describes:

- the development of federal and state regulations to address VHS;
- the perceived effect of these regulations on stakeholders; and
- the level of stakeholder compliance with these regulations.

## **Federal and State Regulations**

Federal regulations relevant to VHS have developed through several stages. Initially, APHIS issued a federal order stopping the movement of fish out of the Great Lakes states:

*We heard it was in the wild then we looked at our regulatory authority and said, well we want to prevent it from spreading from out of the wild and what can we do? ... At that time our advisors, our legal advisors, said that we can't be too specific in these federal orders. We have to be very generic. And if there is disease, you don't want it to spread,*

**Table 1.** Key messages in state fish and wildlife agency and APHIS VHS communication.

	NY	PA	OH	IN	MI	IL	WI	MN	APHIS
Consequences of VHS									
Fish kills/ecological damage	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Impaired uses/economic damage	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Recognizing VHS									
Symptoms in individual fish	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No
Fish kills	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
List of species affected	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Locations where VHS is found	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
How VHS spreads									
People moving fish	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Moving water and equipment	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Fish stocking	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Natural movement of fish	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes
Suggested/required behaviors									
Don't move fish	Req'd	Req'd	Req'd	Sugg.	Req'd	Req'd	Req'd	Sugg	Sugg
Don't move water	Sugg.	Sugg.	-	Sugg.	Req'd	Req'd	Req'd	Sugg.	Req'd
Clean equipment	Sugg.	Sugg.	-	Sugg.	Sugg.	-	Req'd	Sugg.	-
How to respond to infected fish or kills	Sugg.	Sugg.	Req'd	Sugg.	Sugg.	-	Sugg.	Sugg.	-
Buy certified bait	Req'd	-	Req'd	-	Sugg.	-	-	-	-

**Table 2.** Key messages in Sea Grant VHS communication.

		NYSG	PASG	OHSG	INSG	MISG	ILSG	WISG	MNSG
17	Consequences of VHS								
	Fish kills/ecological damage	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Impaired uses/economic damage	Yes	No	Yes	Yes	No	No	No	No
	Recognizing VHS								
	Symptoms in individual fish	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Fish kills	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	List of species affected	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Locations where VHS is found	No	Yes	Yes	Yes	No	No	Yes	Yes
	How VHS spreads								
	People moving fish	No	Yes	Yes	Yes	Yes	Yes	No	Yes
	Moving water and equipment	No	No	No	Yes	Yes	Yes	No	Yes
	Fish stocking	No	Yes	Yes	Yes	No	No	No	Yes
	Natural movement of fish	No	No	No	Yes	Yes	Yes	Yes	Yes
	Suggested/required behaviors								
	Don't move fish	Sugg.	Req'd	Sugg.	Sugg.	Req'd	Req'd	Sugg.	Sugg.
	Don't move water	-	-	Sugg.	-	Req'd.	Req'd.	Sugg.	Sugg.
	Clean equipment	-	-	-	Sugg.	Sugg.	Sugg.	Sugg.	Sugg.
	How to respond to infected fish or kills	-	-	-	Sugg.	Sugg.	Sugg.	Sugg.	Sugg.
	Buy certified bait	Req'd	Req'd	-	-	-	-	-	-

*basically, you can quarantine the area and prevent its spread. So, that was what we were told and that is what we did. We basically quarantined eight states and two Canadian Provinces and said you cannot move animals out of that region. We don't want it to spread. (A-AG-18, APHIS)*

APHIS amended the order a short time later so that commerce in fish could still occur:

*We recognized that we don't want to stop commerce completely. We want to stop the spread of the disease but we have to recognize that commerce is going to happen or wants to happen and so we developed a federal order saying that you could move out of the area if you tested your animals based on known international standards... We couldn't just make up regulations...The federal order would not allow us to do that. We could defer to the international standards, and I think we were trying to be accommodating to commerce while still allowing it to happen. (A-AG-18, APHIS)*

In the fall of 2008, APHIS published an interim rule regarding VHS that was scheduled to go into effect in November of that year. In response to public comments, APHIS initially postponed the implementation of the rule until January 2009 and later delayed it indefinitely. Interview respondents spoke about all three of these stages in APHIS' development of regulations.

In addition, each of the Great Lakes states has developed regulations, which have to be consistent with APHIS' regulations, but may include additional stipulations. Consequently, the regulatory environment is different in different states. For example:

*Our aquaculture business and industry here in Indiana ...is primarily an import business ...We don't ship a lot of fish out of Indiana to other states. ... So we didn't feel like Indiana was putting a lot of other people at risk by exporting VHS from the state, and we never detected it here either. When we put those two pieces together...Indiana was really in a position where our biggest threat was coming into Indiana, and we felt the best thing we could do is to support what is being done by the other states without adding more regulation and not adding more confusion...So we weren't quite as aggressive at creating our own regulations and more requirements. (A-AG-4, state fish and wildlife agency)*

*New York has taken a more aggressive stance on this... The use of shiners is banned for bait...Pennsylvania just has a law that they cannot leave the Lake Erie watershed. (A-S-3, angler/bait dealer/charter boat)*

A number of our respondents commented on the differences in regulations between states.

### **Effects of Regulations on Stakeholders**

The initial APHIS emergency order stopping the interstate movement of fish is perceived to have had a severe impact on the aquaculture industry. Many stakeholders expressed their perceptions of impacts, providing examples of who was affected and how.

*A lot of people were from a lot of states - especially a lot of the private, commercial guys were moving fish and ...they just could not understand it. I mean literally their lives were pulled out from under them. It was an ugly thing. (A-AG-1, state fish and wildlife agency)*

*The only problem with what they did is that their emergency order shut down our ability to operate - 70% of our annual production is shipped interstate... You know when I talk about this I get angry about this... We ship fish all year round and so we ended up parked. We had no ability to engage in commerce... We were stopped. (A-S-13, aquaculture)*

*It was a big effect on our trout industry because we have one large trout group from Michigan that actually - most of their product was going across state lines and everything was getting shut down. So, there were a lot of issues with that. (A-AG-9, Sea Grant)*

*Yes, I think two years ago when they hit us - well they shut us down for three or four months. We couldn't move fish interstate and that is my livelihood. Most of my business is in Connecticut. My father built it - had met a couple of people in the State of Connecticut and became very close friends and felt very comfortable when recommending to us to - you know- people looking for fish and we built our business up there. When they shut me down, for that period of time, basically, that put me out of business. And then they did allow us to do the once a year testing and so far that is working, from what I can see. (A-S-14, aquaculture)*

Once the initial order was amended, interstate trade was possible if aquaculture facilities tested their fish for VHS. Our interviews suggest that most aquaculture operations (except for smaller facilities) may be able to accept these conditions:

*From my personal perspective, I think what they are doing now works pretty well. The facilities that have what APHIS has defined as a secured source, those facilities are testing once a year. That is their general test they have to do once a year to make sure there are no diseases, and then there are also other requirements they bring in live fish ... those would have to be tested as well... The unsecure facilities ... those facilities are now testing twice a year and again with the stipulation that if they bring in live fish from another facility that have not been tested, they would have to have them tested as well... Up to this point we have had zero positive tests. Personally I believe that this is working for aquaculture (A-S-9, aquaculture)*

The burden imposed on smaller aquaculture operations by these testing requirements, however, was perceived to be more than some could bear.

*Another thing is ... the ...strigent requirements for testing ...just do not take into account the economic situation of individuals, producers, haulers. I mean we see cases where the cost of testing and holding exceed the value of the product. So I think we will see - we are seeing - some of these people just giving up and going out of business. (A-AG-16, Sea Grant)*

One state fish and wildlife agency staff member maintained that even the amended order effectively prevented them from trading their products with other states. Because of the order, other states perceived fish from the Great Lakes states as high risk.

*We have been shut down from any kind of interstate trading fish because of this APHIS order and even though APHIS' order permits transport of fish that have been certified VHS-free, we are basically finding that no other state would really want to take our fish anyway because there is always that risk outside of the drainage. So, that has pretty much shut us down ... We have always traded with other states for [certain] species...Georgia for the most part. We are going to try and develop that culture methodology within the state for that but I don't know if it is going to work out or not. (A-AG-12, state fish and wildlife agency)*

Numerous respondents also argued that the differences in regulations between states made commerce difficult.

*We have got a testing standard sort of, which by the way, the states do not agree upon yet. We have a different protocol for Ohio than we have for Indiana than we have for Illinois than we have for Wisconsin than we have for Michigan. We ship into all those states. They are all different. They are all supposedly under the same guidance of the amended emergency order, but they are all different. And so what we end up doing here is an expensive conglomeration testing program...We are testing a lot of fish, we are sacrificing a lot of fish, a lot of fish are going to the lab, it is expensive, a lot of issues surrounding that. (A-S-13, aquaculture)*

Based on comments from the range of stakeholders and agency staff interviewed, it appears to be widely believed that the requirements of APHIS' indefinitely delayed interim rule would have been excessive.

*Our aquaculture guys ...a lot of them are trout producers, and they are going to think how much more can we afford before we are out of business. There is a lot of concern in the industry at that rate now. Because we got one of our biggest guys ...if this new regulation goes through that we've got to start testing every month - he could be gone you know. (A-AG-9, Sea Grant)*

*They could not afford the tests. I mean, the testing...some of these guys are spending \$10,000 a year on testing right now. We're talking almost a thousand dollars a month some of them are spending. It just - if they made them test any more than that, there is no way they can afford that. (A-S-17, aquaculture)*

*I mean, if the purpose is to protect farms it's not just from VHS it's to protect the farm so it can survive - then what good does the regulation do if the regulation kills the farm without any movement of VHS? And that is what we are really risking here - you won't find any farm that has been harmed by the disease - but you will find a whole lot of them*

*that have gone through great harm because of the regulation and not one farm has had VHS. (A-S-18, aquaculture)*

The silver lining, from the perspective of some respondents, is that the advent of VHS and the regulations designed to address it have served as a “wake up call” to producers, which has encouraged them to develop better biosecurity procedures.

*I worked with a couple of farms ... on developing some biosecurity plans. At this point, they got lucky that VHS occurred and really prompted the development of these biosecurity plans because it is probably something they should have had in place. (A-AG-15, Sea Grant)*

*This is one of those things that I can say was a positive with VHS is was a big wake up call for this entire industry - the private sector, the public sector, tribes, the state hatcheries, the federal, everyone. It was a big wake up call for everyone...I believe five years from now, VHS is going to be old news. However, it is a wakeup call for us and everyone else. We can end up doing a better job than what we have been doing and clean up things a little bit more and sure that we are selling a quality product to our customers and go forward. (A-S-7, bait dealer/aquaculture)*

The impacts of regulations on bait dealers have been somewhat similar to those on aquaculture operations. However, regulations on harvest are more relevant to bait dealers. These regulations have varied from state to state.

*We ... closed off bait harvest which had already been done previously... so that we don't have anglers moving ... fish. (A-AG-2, state fish and wildlife agency)*

*Well, we have made huge changes to commercial bait fish harvesters. We have taken waters off the list of where they can collect natural bait. We have required disease free certification for all bait sold in New York State and that is probably the biggest single thing we have done. We do allow some harvest of wild bait commercially but then they have to be certified before they can be sold and that is not done very often. Certification is pretty expensive and you never know if they are going to pass or not. There is quite a long wait time that they have to keep bait alive so not much of that is going on. We have kind of restricted the commercial sale of bait primarily to farm raised bait because of our regulations. (A-AG-14, state fish and wildlife agency)*

The testing requirements seemed to be perceived as particularly burdensome on wild bait dealers.

*It was costing me about on an average anywhere from \$1,400 to \$2,000. Some months more...It was getting me pretty good...broke me that's what it did... The testing last year and year before just killed us... I don't mind the testing, it was how much we had to do it and how often. (A-S-2, wild bait)*

Given that New York placed the most stringent restrictions on bait dealers, respondents perceived the industry was affected particularly there.

*I took the biggest hit out of it than anybody... The very next day ... we just cleaned our staff out. It was like ten people lost their job. "You're gone, you're gone." It was their total livelihood and there are still some of them who are totally unemployed all this time. (A-S-5, bait dealer)*

*I don't have the figures but we had a number of small operators both commercial bait business and private aquaculture say they were going to go out of business. And I don't know if we have any records to indicate how many did but generally they were pretty small - part time operations ... At least they said our regulations were going to cause them to go out of business and I don't think we have the actual figures as to how many did. (A-AG-14, state fish and wildlife agency)*

Several bait dealers maintained that the key to being able to survive was a willingness to adapt their operations to the new conditions

*The guys that are going to be affected the most are the ones who are not cleaning the minnows up. When you get minnows off the river ... there are several of the species that are on the APHIS list ... All can be caught in with these minnows and they have to be cleaned up because those minnows can not be transported off the river they are caught on. DNR has not enforced this yet but this year they are going to enforce it... Now for me that is not a problem. For some of these guys it is going to be a problem because ... their attitude is why should I clean the junk out of my minnows? I get the same price for the junk as I do for the minnow I am selling. And that is the problem with the industry ... The only way that I know to deal with it is to eliminate that part of the industry... A lot of people ... are going to be affected by it because of the fact they are going to have to take more time to clean up their minnows, which means they are probably not going to be producing anywhere near as many minnows as they produced before. To be honest with you, I don't see that as a bad thing. (A-S-4, wild bait/aquaculture)*

*As far as the effects of it in our business, we have kind of adapted... What we did, knowing this was coming - and we knew we were not going to be able to get products from out of state unless it was certified - we purchased, we have minnow boats on the water. I made a deal for a second minnow boat so now we have two minnow boats... And this year, the last two years, we really didn't have any problems more than we normally do... We were able to supply pretty good ourselves. (A-S-10, bait dealer)*

One strategy for adapting to the new conditions has been to switch to selling different bait fish.

*When the lake shiner became a susceptible species on the APHIS list ... we sold our inventory and we haven't done anything with them since and that has been two or three years ago. (A-S-7, bait dealer/aquaculture)*

*We no longer ship into Erie, Pennsylvania ... except for golden shiners and fatheads which is not on the APHIS list. Same way with in Michigan now. We still do ship bait in there but again the golden shiner or the fathead minnows again are not on the list. (A-S-10, bait dealer)*

One aquaculture operator maintained that some of the negative effects the bait industry was experiencing were likely due to the poor economic conditions and not the regulatory environment.

*I can't sit here and tell you that this quarantine had huge adverse affects on the industry. It definitely has retracted the aquaculture industry because of the uncertainty, but in all fairness and keeping things in perspective I think...you are going to talk to people that are going to just scream that this is killing the industry and the reason that they are not selling any fish... whereas I think the economy has a great deal to do with that as well. In your interviews and your research when you talk to people from some of the states especially when you get into the bait industry, they are going to scream foul and rightly so, but you know two of those fast balls they struck at ... that was in the form of the economy and the other is the bad pitch that is coming from APHIS on this. (A-S-19, aquaculture)*

Most of the discussion of how anglers have been affected by the new regulations also centered on bait. Some states have required the use of certified bait and others have encouraged it.

*We have made anglers responsible for their actions ...they are the responsible party for how the bait gets used. We have put a certification process in place so that if you have certified bait you can use it anywhere in the state...If it is uncertified bait, it is restricted as to where it can be used ...And we have made the anglers the responsible party ultimately. They are the ones who are going to use the bait, not the bait industry. So the idea is to make this an educational vehicle to get anglers responsible for their actions for fish health. Which is the first time, frankly, that we have done this. (A-AG-8, state fish and wildlife agency)*

*Any bait they buy has to be certified disease free so that has been a substantial change. Prior to VHS regulations many, many anglers caught their own bait and moved it to wherever they were going to fish and ... we basically eliminated that. We do have a clause in our regulations that allows a person to collect bait themselves and use it on that very same body of water immediately. They can't put it in their car and take it somewhere else...can't transport it over land, can't take it to any other body of water, can't save it until the next day, they can't salt their own bait not like they used to. So we have restricted the individual collection of bait dramatically... That has a dramatic impact on anglers who use bait. (A-AG-14, state fish and wildlife agency)*

States have also restricted the movement of bait.

*Our committee advised the state veterinarian on establishing a quarantine zone around Lake Erie within the State of Ohio. He issued an order that a fish from Lake Erie or their*

*eggs ...live fish - could not be transported out of that quarantine zone. (A-AG-16, Sea Grant)*

One result of restrictions on anglers and bait has been a lower availability of bait – in particular, lower availability of certain species. A number of respondents argued that this condition has discouraged fishing and had negative consequences on communities that are economically dependent on fishing.

*Well, because it was difficult to get bait, it changed how or what we were doing fishing wise. There are several thousand people that fish the Great Lakes, and use what they call cut bait which is herring from the Pacific Coast or the Atlantic Coast. I forget where it comes from but it has to be certified and VHS free. When that is the type of fish I am used to and when this happens practically overnight and there is no source to get your bait, it really puts kind of a crunch on the way you are used to doing things. If you got a tournament planned and all set ready to go...it's like somebody walks up to me and, well, you know what, starting next week, we can't use gasoline in your car. (A-S-15, angler)*

*The potential is there for the live bait industry and the sports fishing industry - it has been very hard hit since we can't bring emerald shiners from other parts of Lake Erie where they are abundant... It just so happens that over the last couple of seasons that the federal orders have been in place, they have been able to secure local stocks but these are very, very variable and inconsistent... There will be years when just bait supplies are going to dry up and the sports fishing industry is very large with a huge economic footprint and taking away something like the live bait that they rely on will just mean that people will just stop doing that... I cannot say that Ohio has felt it in a significant way yet, but it is only because of variability of supplies. We have been lucky to be on the up side of the curve for the last couple of seasons. (A-AG-16, Sea Grant)*

*Well, on the Great Lakes ...some days you don't catch anything unless you have emerald shiners... It affected the tourism up there...the guys would call from Columbus and Pittsburgh ...and find out if they have shiners and if they don't have them, they won't come. So, the hotel rooms don't get filled and gas stations, food places - it is dead times. (A-S-5, bait dealer)*

*Along here we are a very depressed area. Our economy is totally shot. Our industrial base is dwindled down to nothing. The steel plants we used to have, big automobile and all the related industries attached to it have gone under. So ... this has a big effect of our area. You got a lot of people ... they just love to go out on Lake Erie and perch fish. I can remember where it would be nothing 100 to 150 boats out there just perch fishing. Now, you still get quite a few maybe 30 to 40 boats but you are no longer seeing those 100 to 150 boats. (A-S-8, angler)*

Much, but not all, of the concern about bait availability was rooted in a concern about the availability of emerald shiners. One bait dealer argued that the perceived superiority of emerald shiners as a bait fish was unfounded.

*The golden shiner is a positive substitute for the emerald shiner, yes. If someone was to corner me on that, I believe in it... We switched with the smaller golden shiner in the 2 to 4 inch range - comparable to the emerald shiner... To be honest we did lose customers at first ... They were significantly more money. When you harvest something from the wild, you have virtually nothing invested. When you are growing the stuff you know the transportation and all that stuff then you have a heck of a lot more stuff in them... That was two years ago, and since then we have gotten the majority of our customer base back... To be honest, there aren't any of our customers right now ...I don't think you would find a single one of our customers, if you were to walk in today and give them lake shiners, the emerald shiners, I don't think any of our customers would end up taking them. (A-S-7, bait dealer/aquaculture)*

One angler argued that the lack of availability of bait was temporary, and the situation has improved.

*Bait was really hard to get a year and a half ago. Now it seems to be a lot easier because of the VHS rule. (A-S-11, angler)*

### **Compliance**

The perceptions of our interview respondents were that compliance with VHS regulations and recommendations differed for different groups.

*We have had people allude to the fact that anglers are still collecting bait from one water and taking it to another to go fishing... Some of the commercial bait dealers are still collecting fish from the wild and selling them certified disease free and things of that nature. I think the aquaculture industry is probably complying better than anyone else I suspect. In terms of what percentage you think are complying, I don't think we could do anything but guess. I think we wish it was higher compliance. (A-AG-14, state fish and wildlife agency)*

Among people we spoke with, the belief was widespread that compliance among anglers was fairly low.

*It is against the law already for people to move fish to public waters. It has been against the law all along. But, you know, how many people would know or care. ...I am a fisherman and I guarantee you I can move emerald shiners anywhere I want ...They are popular inland ...because they are bigger bait. But they want to use them, people will move them. (A-AG-1, state fish and wildlife agency)*

*Anglers ...I think most people would view as being in fairly poor compliance in terms of some of the requirements as far as bait, bait fish used and movement. (A-AG-20, state agriculture agency)*

*I had an opportunity to fish with a couple of guides - the way they were handling their bait between water bodies I know was insufficient to prevent the spread of VHS from one body of water to another. (A-AG-15, Sea Grant)*

*I don't think anybody has been fined for transporting emerald shiners... The way that they are getting these emerald shiners and bringing them out it is basically illegal. And you know these guys come in with these catches and what are you using and they tell them anything under the sun. It is all lies... They go down to the river and they transport the bait. They catch the bait and transport them out there. (A-S-8, angler)*

*The bait dealers are complying with it - because everybody is afraid of a high fine. But the fishermen could care less... They give them a \$50 fine. For 50 minnows in my store, you are paying six dollars... So these fishermen in their best interest just keep going and catch their own because of the price of bait. They can still get caught but they are still ahead of the game. It is a no brainer. If I was going to go fishing, I would go catch my own. I wouldn't care. But I am in a business and I can't afford - I can't take any hits, because it is my business. (A-S-5, bait dealer)*

Although most of the discussion of anglers' compliance focused on bait fish, several people also described a perceived lack of compliance with recommendations to clean boats and drain water from boats before moving them from one body of water to another.

*There probably should be something set up - wash down system... I mean Sea Grant and DNR suggests that you rinse your boats out before transporting them to the other lake. I really don't think anybody is doing that... not a convenient way to do it. (A-S-11, angler)*

*The transportation of water in a live well or bilge, now there is an area where you can easily transport water... and it is scary. Have we educated everybody enough? No. And therein lies the nightmare. Have we educated everybody to clean their trailers before they leave this body of water? Once they got on shore, they transport the boat to another lake later that day. Has it been cleaned? Have we done a thorough job of educating everybody 100%? No. Therein lies the nightmare. (A-S-16, angler)*

One person argued that with fewer stories in the press about VHS, angler compliance was becoming even lower.

*I kind of have a sense that that fear - or almost a paranoia - has been reduced and that's good and it's bad. Certainly, it is good because we don't want people running around in hysteria. It's bad, too, in that they are more lax in how they are handling their bait fish between bodies of water. (A-AG-15, Sea Grant)*

More than one respondent argued that the evidence was strong that a lack of compliance among anglers had contributed to the spread of VHS.

*I think that the response from anglers as is always the case ...is variable. Some anglers just don't give a rat's butt. Others try and do the right thing...It is ...clear that we have*

*seen jumps of VHS ...in a number of states where we really can't point to anything other than anglers...And so it is clear the response has not been effective. Anglers are in one form or another by themselves not cleaning out live wells ... or ... reusing bait, something like that. VHS is spread that way. (A-AG-5, state fish and wildlife agency)*

Although the vast majority of people we spoke with believed that compliance among anglers was low, some believed it was adequate.

*I don't think it is a big deal for most people to make sure the boat is cleaned - that is good boating and good practice anyways. So, I don't think that was a big effect. I think where some of it may come into play is people are buying maybe a couple dozen minnows if they are going to do some other type of fishing and if they didn't use those minnows up they were used to just dumping them in the lake. Well, they were told not to do that... I would say that probably the majority of these people did not have a problem with that. (A-S-15, angler)*

When discussing bait dealers, most respondents believed that their compliance with VHS regulations was imperfect.

*Talking with representatives from different jurisdictions, some of them feel that implementation of the regulations is generally going along in a pretty reasonable way ...I think they feel like they are getting at least reasonable compliance ...In other cases, we know that perhaps there has been more adversarial between those stakeholders and the regulators and that has created more conflict. I think overall, states ...are in a situation where they are not completely confident that illegal activity with regard to collection or movement of bait is not occurring. And certainly ...having been at some of our law enforcement meetings, it is quite clear that the law enforcement ...officers recognize that there is extensive illegal movement of bait within and through the basin. They just know that. And so we know that there are large loopholes despite the intent of the regulation. (A-AG-5, state fish and wildlife agency)*

*You know my recommendation is, and I will be candidly honest with you on this as somewhat of a rebel advocate, I have said screw it. Let's go across the lines and let APHIS arrest us and take it to court and you know let the dust settle on this. I think when it goes to Federal Court, I think there is going to be a lot of embarrassment and it hasn't happened yet. You notice there has not been any major crackdown. And I can guarantee you that bait is coming into our state constantly illegally. It is coming out of your state because those people have to survive and they don't see the common sense of the rhyme or reason to what we are doing. (A-S-19, aquaculture)*

Some respondents maintained that the wild bait industry was more likely to violate regulations than the cultivated bait industry.

*The people in the wild bait industry will not change unless they are forced to change. You go out ... harvesting emerald shiners out of the wild, you are going to have very little sunk into those fish...you are not going [to] have the respect for those fish as if you were*

*raising them. If they die, they go bad and once you pull the drain on your tank, dump them out in the field and no big deal and you will go out and catch some more. From my side of things and the farmers' and the producers' side of things I have a problem with my fish I am going to work ... to rectify that problem... We got a lot more invested in them. (A-S-7, bait dealer/aquaculture)*

The perception of some of the people we spoke with, however, was that compliance among bait dealers was adequate.

*Usually they will comply with it... They take our word for it that it could kill a lot of fish, and they don't want to be one of the vectors that could have been the cause. They are fairly cooperative in going where we tell them they should be not where we tell them they shouldn't be. (A-AG-3, state fish and wildlife agency)*

Most people we interviewed believe that, because aquaculture operations typically have considerable resources invested in their businesses, compliance among operators was quite high.

*The majority they all are abiding because ...people are very upset about the interim rule. Now if they weren't abiding by the regulations, they wouldn't care about the interim rule. But because they were so upset with the regulations that we put forth, it makes me believe that they are doing what we ask them to do. (A-AG-18, APHIS)*

Several people observed that the capacity for changing behaviors through regulations was limited, and, therefore, a more comprehensive approach was needed that also focused on encouraging voluntary behavior change.

*Everyone recognizes ...we are trying to change human behavior. That is what we are trying to do. So we decided to do an educational campaign, and if we can't regulate them at least we can educate them... How can we ...encourage those people to stop doing what they are doing and in turn stop spreading the pathogen? So, I think that we were thoughtful ...on one hand regulating what we could and trying slow the spread down that way and at the same time trying to do what we can in areas where we don't have authority. So, on the one hand we were hard handed and on the other hand we were very thoughtful. (A-AG-20, state agriculture agency)*

## **Factors Influencing Compliance**

A wide variety of factors likely influenced compliance with VHS regulations and recommendations. These included:

- awareness of and concern about VHS;
- the costs and benefits of compliance;
- the feasibility of compliance;
- the level of enforcement of regulations;
- the perceived adequacy of regulations for managing VHS; and
- the perceived fairness of regulations.

## Awareness and Concern

Our respondents argued both that awareness of VHS would increase compliance with regulations and recommendations and that this awareness was generally growing.

*All of us whether we are bait dealers, anglers, NGOs, or agencies, we all have that same vested interest ...preventing the spread...I think education is the most powerful tool ... So I think that if these groups are educated on the topic and they fully understand the impact this disease can have, not only on the environment, but on the fishery as well, they are going to be more likely to comply with the regulations. (A-AG-11, Sea Grant)*

*I think they are more and more aware as we move forward... The State had a meeting ...when VHS was first coming on strong and there was a lot of people who didn't have a clue as to what it was... Well, since then there has been a lot of talk about you seen it in the paper and what is safe and things like that. I don't think you see it as much or talk about as you did a year ago. But, yeah, awareness has become you know greater. (A-S-15, angler)*

Awareness of the presence of VHS is not the only consideration, however. Stakeholders also must be aware of how their behaviors influence the spread of the disease. Some respondents argued that anglers' awareness had increased in this regard.

*Things that people are used to doing - taking eggs from steelhead and going downstate and fishing for trout with them - that has been a long-standing practice for some and I don't think we are seeing a lot of that now...I think it is in the angler's interest not to spread this stuff. I think they're generally going to be interested in trying to comply with this stuff. (A-AG-12, state fish and wildlife agency)*

*I think in cases we just needed to educate them that there was a risk involved when they move fish from one body of water to the another...It used to be quite a common practice for people to ... catch some live bass from a big lake and take them home and put them in their farm pond. ... I don't think many of them realized that there was ...a risk in doing that. (A-AG-14, state fish and wildlife agency)*

Others argued, however, that many anglers still were not aware of how their behavior contributed to the spread of VHS.

*It sounds like there are a lot of people that aren't aware that VHS is an issue. If they are not aware of that right now, probably they are not all that familiar with these preventive steps that can be taken so to say that we have made a lot of progress there...I think the overall message was a lot of work needs to be done. (A-AG-4, state fish and wildlife agency)*

*But I think, yeah, we've got information out there. If it is getting to the average boating, weekend boater, I don't know. That's where I think it'd have to be addressed more and I*

*don't know exactly how you would do that effectively. That is where I think you are going to run into more problems on transferring it from one water body to another just on your recreational boater that doesn't know anything about it. You know he is carrying his bait from one place to the next and who knows what he is doing and not dumping his water or whatever. (A-S-17, aquaculture)*

Awareness of VHS among other stakeholder groups, particularly aquaculture operators, was generally perceived as quite high.

*Aquaculture people - they are aware of it. At least the ones I deal with - they are all aware of it... They are aware of what is going on and they are doing what they have to do to keep up with the testing and you know the regulations you have here. (A-S-17, aquaculture)*

However, many of our respondents also argued that considerable confusion about VHS existed because information about the disease and the regulations being used to manage it was changing so quickly.

*I think that there is a pretty good deal of confusion or even ignorance in the general public concerning VHS. There has been so much going on so rapidly so many regulations I don't know how the public can keep up with it. It is hard enough for us to keep up. I think it would be pretty idealistic to think that we are on top of this. (A-AG-12, state fish and wildlife agency)*

*He pretty much ... told me what I had to do. And I don't know if I am legal in what I am doing. It changes so fast and so much in the last two years and so many rules. (A-S-2, wild bait)*

Many were frustrated at their inability to be sure that the information they had about compliance was correct.

*Call for information - here we have worked with Extension, we have worked with Wisconsin Ag, we have worked with DNR, talked with APHIS. But you get different interpretations. To take fish into Pennsylvania, this was three years ago, six phone calls later, before I finally got an answer what is required to take fish into Pennsylvania. That is wrong. Ohio, I called Ohio, this has been last year - and I got two different people - two totally different answers... We are trying to comply with the law but you get different interpretation of it. (A-S-7, bait dealer/aquaculture)*

*What I would really to see - I think would help all the bait dealers and the fish farmers is when we renew our license, when we get out bait dealers license or ag permits or something like that, it would be nice if they would ...list the current regulations and spell it out really clear and that would really help us a lot. And that is not being done. As a matter of fact, even the last time, this year when I renewed my ag license... they sent very little information ... they didn't spell it out like they did in the past. (A-S-10, bait dealer)*

Awareness of VHS and VHS regulations is one influence on compliance, and concern about VHS is another. People might be aware of VHS without being concerned about it. We suggest above that concern about VHS had decreased some what. Some interview respondents maintained that a lower level of concern led to a lower level of compliance.

*I think a few initially were not aware of the regulations when they first came into effect. I think by now everyone is aware but there are still some people believe that it is not necessary and I think they are choosing to ignore it. (A-AG-14, state fish and wildlife agency)*

*I don't think it is as serious as it should be from the general angler public. You know Pennsylvania Fish and Boat Commission enacted some laws with transportation of emerald shiner minnows and you know I don't think on the most part most boat guys are real concerned ...or believe what it could do. I have had some guys bitching about why we can't take these minnows such and such places... I don't think it is taken as serious as it should be. Everybody seems to – “Oh yeah. That disease has been in the Great Lakes forever and now all of a sudden they are focusing on it.” (A-S-3, angler/bait dealer/charter boat)*

### **Costs and Benefits of Compliance**

It was clear from our respondents that they believed that compliance with regulations and recommendations was influenced by the costs and benefits of compliance. Some argued that those businesses least likely to comply with regulations were those for whom the viability of their business would be threatened if they undertook efforts to comply.

*There are two different ways to look at it... I remember one of the guys at the seminar we had who had grown up on Lake Erie ...he would do anything that it would take to protect the Great Lakes and he was the one who was all for anything that needs to be done, we need to do it... And then there were other people who were more concerned with their business and of course if your livelihood is at stake, you are going to be less likely to follow the regulations if you are worried about your livelihood. (A-AG-11, Sea Grant)*

In general, larger aquaculture operations and bait dealers were believed to be better able to afford the costs of complying with the regulations and, consequently, more likely to comply. Larger businesses, because they are more visible, are also believed to be more likely to be held accountable if they fail to comply.

*The commercial bait dealers - I think the larger ones are more likely to be complying than the real small dealers. It is important to their livelihood. They are careful to follow the rules they don't want to lose their license or whatever. I think the real small time operations may be more likely to violate the rules because they can less afford the testing or less afford to take the risk of losing large numbers of minnows that they have paid more for than before these regulations went into effect. (A-AG-14, state fish and wildlife agency)*

*Well, I think those people that are more visible ...the fish processing people. They also have bait ponds in which they rear bait fish to a marketable size and sell them directly to bait dealers. I think people like that - that have large visible facilities vs. those folks that go out there with nets and grab them in tanks and sell them directly to bait dealers - you know those more visible facilities are more likely to go along with the regs. (A-AG-7, Sea Grant)*

Compliance of bait dealers is also perceived to be influenced by market forces. When anglers demand certified bait, respondents believe bait dealers are encouraged to produce it.

*I think anglers are more cognizant than they ever were about bait... They were screaming for certified bait so the market adapted much more quickly than we anticipated...A lot of them said they didn't want to deal with this uncertified stuff - I just want certified bait... Or they switched to species ...that have been shown not to have VHS like fatheads and said I just don't want to carry emerald shiners, for example. (A-AG-8, state fish and wildlife agency)*

Economic forces were not the only ones that were perceived to influence the costs and benefits of compliance. Some respondents argued that certain types of fishing were not feasible without certain types of bait. Anglers that depended on these types of bait would be less likely to abide by regulations that restricted them.

*In terms of anglers...the complaints we are receiving are that anglers fishing for perch, which is a fishing method that requires lots of live bait, are most likely violating our rules ...I think it is the desire to have lots of inexpensive minnows for your fishing efforts. You tend to use lots of minnows when perch fishing. (A-AG-14, state fish and wildlife agency)*

*There is a large amount of wild bait fish harvest - let's say for example in the Niagara River area...These wild bait fish are the prime bait used, for example, fishing for yellow perch and other species... This type of fishing is so effective that using an alternative would ...obviously reduce harvest. (A-AG-7, Sea Grant)*

### **Feasibility of Compliance**

The compliance of bait dealers and aquaculture operations with the indefinitely delayed interim rule was considered impossible by many people with whom we spoke.

*I thought the rules were generally unworkable the way it was put together and again, I was disappointed at how they did things. I was disappointed that they did not ask or discuss - we could have helped them through this process - given them information - they could have asked for information... The rule is just unworkable the way it is now - it makes my head hurt. (A-AG-8, state fish and wildlife agency)*

Two general concerns about the rule existed. One concern was that the personnel with the necessary expertise to carry out requirements of the proposed rule simply were not available.

*The visual inspections that they are asking for – it's pretty hard to tell if a fish has VHS, so if you have to go find someone to do this. How will you logistically get people who are willing to sign off?... You will have to find either a vet or health expert that is going to ...come and look at your hatchery and your pond situation to see if there are visible signs...The vets we have talked to locally don't even want to do this so that would completely bottleneck us right there. (A-AG-6, tribe)*

*In general, I think about everyone I work with - they are ok with the testing as long as there is somebody to do it... That was the major concern and why I actually got authorized to do it because there just wasn't anybody here ... that could do it. And so that was the major deal when it first came out for the testing they were concerned about who is going to test - how much is it going to cost - is there anybody there that can even do it, which there really wasn't. (A-S-17, aquaculture)*

*The cost of the amended Federal Order, the industry can bear it - it does create a bit of unfair economic advantage to one and not the other but they can bear that cost. If the interim rule would have gone into effect, they could not have borne that cost... That'll be a pretty quick catastrophic kill off of industry... You needed a vet there a couple times a week to test the shipments, and you needed a vet there to check the disinfectant when you are disinfecting a vehicle when you needed to disinfect every trip ... and then separate from the cost the fact that the people aren't in place to do those inspections. So, even if you had the money, you probably couldn't have gotten the people out there when you needed them because they didn't exist - the numbers necessary. (A-S-18, aquaculture)*

*And this whole idea of every truck load has to be inspected by a veterinarian before it left the farm. Good grief, how in the world does that happen? Again, logistically, there aren't even enough veterinarians with fish knowledge to make it happen if you could afford it... And you are not going to be able to find a veterinarian who would sign on the dotted line... That whole idea was worthless at best. (A-S-13, aquaculture)*

The other primary concern was that it was infeasible to test fish as frequently as required.

*It would require ...our facility to test our fish, to go through what we would normally do on an annual basis, every thirty days. Every thirty days. Two things, one we don't have time to do that and number 2 we don't have the money in terms of fish, in terms of labor and in terms of an incredible lab bill. It would have put us out of business, no ifs, ands or buts. And you throw into that the fact that it was logistically impossible to meet because it takes over thirty days to get your test results back. So we would have been expired before we even had our certificate. The whole thing was just - it looked like APHIS was asleep at the switch. (A-S-13, aquaculture)*

*To do a complete VHS test to make sure your facility is negative, it takes almost thirty days - going by standard procedures. And when you read the interim rule, for certain facilities, they had to get tested every month ... if you consider it takes almost thirty days to get your results back - in reality, for most facilities it takes more than thirty days to get*

*the results back - technically if they were to follow the interim rule they would never be able to sell live fish. (A-S-9, aquaculture)*

## **Enforcement**

Most interview respondents who discussed enforcement of regulations believed that enforcement would encourage compliance.

*You don't find out until you go out there and start checking and as you check you begin to see even for those people who have not been inspected, they begin to change their activities and so there are some people that begin to comply and there are other people who cease their activities because they would rather not, because they don't want to follow the rules and or they view them as too costly and so they reduce their activity. (A-AG-20, state agriculture agency)*

However, most respondents also believed that agency capacity for enforcing these regulations was very limited. They made this argument with respect to anglers:

*Nobody has the time or money to enforce people - checking everybody moving from spot-to-spot... You can't clean a boat - that's a joke. (A-AG-1, state fish and wildlife agency)*

*We haven't had too many enforcement actions taken against anglers... That kind of thing - it is really hard to enforce... It is hard to prove that somebody - once they get on the road it is hard to prove they just left the water or just came from the bait shop or whatever... We just hope that people do it for the good of resource. (A-AG-3, state fish and wildlife agency)*

*Those states are critically short of conservation officers. And so they just don't have the manpower ... to track it all. Having said that, if you can make a few busts that goes a long way to discouraging a lot of those people ... and only the committed dishonest people still proceed. (A-AG-5, GLFC)*

*The only regulation that we really deal with right now is the transportation of live fish out of the Lake Erie watershed. And of course the trout eggs and salmon eggs - a lot of guys will take fresh eggs and use them downstate for their angler trout fishing and that has also been banned. I don't think that has been enforced either. It is pretty hard to enforce... There are millions of guys on the stream that weekend and very few officers out there - the last thing they have to deal with is when they look at your minnows or check your eggs you are using. (A-S-3, angler/bait dealer/charter boat)*

Our respondents also believed it was difficult to enforce regulations with bait dealers and aquaculture operations.

*One concern that I have is that there is very little enforcement out there should people sidestep the regulations...I mean the penalties for violation of the federal order ... are fairly stiff. I think that has people's attention and I think there is also an awareness that*

*we have only one APHIS inspector here... And, it doesn't fall to the responsibility - things like wildlife officers to try and enforce and enable APHIS regulations. I mean they may report it or something like that. They are not going around looking to see if people have their license. (A-AG-16, Sea Grant)*

*We do have enforcement authority. We are supposed to be enforcing it but very little enforcing actually happens. Essentially happens by word of mouth... We only have two inspectors per state. Our budget is small and usually we don't have any real boots on the ground. We rely on the states to stop trucks and lock the borders and things like that so we really rely on people to do what is required of them. We have received a couple of calls from people about breaking the law, but it is usually neighbors of an aquaculturist where someone is abiding by the law and it is costing him a lot of money, but Joe down the street is just moving his fish untested. So we have had some calls saying Joe is doing this. He moves his fish late at night, and I know they are untested and we go out and try to see what the situation is. That is really about the only enforcement we have. (A-AG-20, state agriculture agency)*

*To be honest with you I have been in the business twenty years and I have never been checked by a warden even so much as for my license. And, I don't know of anybody else who ever has unless they were caught in the act of doing something wrong. There just aren't resources ... to put enough enforcement out there to catch what is going on. (A-S-4, wild bait/aquaculture)*

### **Adequacy of Regulations**

Attitudes toward regulations and behavioral recommendations, which could influence compliance, were shaped by how adequate stakeholders believed these regulations were for addressing VHS. Whereas onerous regulations might be acceptable if they would limit the spread of VHS, they would be much less acceptable if they were perceived as ineffective. Interview respondents identified several key areas of concern about the adequacy of VHS regulations. The first area of concern was that no steps had been taken to regulate ballast water, which was widely seen as the most likely factor contributing to the spread of VHS.

*All this effort to prevent the spread under APHIS' first rule – a large part of it was negated by things they didn't address. Primarily, ballast water discharge was a glaring oversight. They just did not handle it - too much for them. So, here they are preventing interstate transport over land. Meanwhile water is being shipped all over the Great Lakes Basin...across state lines. (A-AG-6, tribe)*

*Most of the experts that are talking about how this has gotten into the Great Lakes system and how it has moved so far ... tell us that it is likely to have come in and is being moved around in ballast water, ok? APHIS ... “We feel that is something not within our jurisdiction and so we are going to leave it to the Coast Guard.” ... Our response to that vector is - nothing. Instead of that we are going to regulate fish farms - fish farms which by the way historically have none in their facilities but maybe someday will have VHS. (A-S-13, aquaculture)*

Several respondents expressed the belief that the shipping industry's political influence prevented any meaningful steps from being taken to regulate ballast water.

*If they wanted to do this they should have done it twenty years ago. They should have said all foreign ships coming in ... they have to abide by our rules and regulations. But the shipping industry is a hell of a lot strong and bigger and more money than ... to allow this stuff. (A-S-8, angler)*

*The commercial shipping industry introduced this critter here, and I even put the fault on the boaters, the anglers because they are spreading it to another lake. I said, you haven't done diddly squat... You know, you are not going to hold us accountable for something that the major shipping industry is doing and because Congress is inept at passing meaningful regulations on ballast water management. They can't, they won't, and they don't want to. They don't consider it a big enough issue. There is enough lobbying by the international shippers to have withstood meaningful legislation. So now you are going to hold the recreational, boating, and angler community accountable. Nonsense. It ain't gonna happen. (A-S-16, angler)*

The second major concern about the adequacy of VHS regulations was that these regulations effectively ignored the Great Lakes connection to the Mississippi River through the Chicago Canal. Although VHS has never been detected in Lake Superior, VHS regulations apply to Lake Superior because it is connected to the other Great Lakes. However, the same logic was not applied to the states that were connected to the Great Lakes through the Chicago Canal.

*We know that Lake Michigan dumps into the Mississippi River so in trying to prevent it from again crossing state lines by truck, water is flowing out constantly in the ship canal there... Government often says we have to do the best we can and then that is fair but ...you've got to make sure that it is necessary and balanced and we are beginning to think now that because VHS isn't causing any big problems anywhere...maybe it isn't balanced and fair. (A-AG-6, tribe)*

*They have completely ignored the Chicago Canal which is a multi-billion gallon withdrawal every day - looks like a river that flows out of the bottom of Lake Michigan and into the Mississippi drainage. Ignored it. You know, we have said why is Minnesota in this? "They have a border with Lake Superior. Lake Superior is a Great Lake, so Minnesota has to be included." And we said, well, there is no VHS in Lake Superior... So it is being included in this because they have a border with the Great Lakes whether it is infected at this time or not. Now, following that logic you would have to say that a multi-billion gallon river withdrawal which connects to the Mississippi drainage would be an equal threat wouldn't it?... So, if you are going to follow that logic you need to go down the Mississippi drainage and you need to connect every state that is in the Mississippi drainage - which of course, would be a political disaster so APHIS naturally didn't do it. (A-S-13, aquaculture)*

Several aquaculture operators and bait dealers also expressed concern about the adequacy of regulations given that the behavior of anglers, who were far more likely to contribute to the spread of VHS, was not effectively being addressed.

*I've got an even bigger problem ... if they are not going to deal with the other vectors in some sort of an intelligent way. OK, we have seen a little bit of movement of trying to communicate with the general public about moving live fish in sport fishing and emptying your wells and washing your boat and blah, blah. How much of that do you think really happens? ... I mean that study has been done and it is very low compliance... People yank their boats in and out of there and do what they want. How are we going to cope with that threat? Are they requiring that a boat putting into launch present the certificate of cleansing? No... If you are not going to do it right, and you are not going to deal with the vectors, what are you doing? In the end are you going to influence the overall spread of this virus? The answer is no. (A-S-13, aquaculture)*

*My biggest concern for the spread of VHS is really that there is nothing much done to target other water users - specifically, boat users, anglers who are going to far more likely to transfer disease than a commercial aquaculture operator (A-S-9, aquaculture)*

*I just called last week - you know DEC - and they were cutting holes getting ready to get bait but by the time they got there all the guys were gone. We figured that if they really clamped down it was going to be better for our business ... but the fishermen need the emerald shiners and they are going to just go around the regulations to get it and it is very easy bait fish to catch...So, they really are not stopping anything. They think they have solved the world's problems and they haven't stopped anything at all. (A-S-5, bait dealer)*

One bait dealer and aquaculture operator also argued that loopholes existed, which allowed the use of potentially VHS-positive fish.

*One of the things that I have a serious problem with is smelt. How come there is smelting allowed to be used for bait that are coming out of positive waters and can be moved from one end of the country to the other with no health testing? A perfect example - I can go into Lake Ontario, harvest smelt in October, November and I don't know if it is legal or not but I am using this as an example. I can go in and harvest smelt, freeze them, which does not kill the virus, and I can bring them from Lake Ontario all the way over here ... I can use them in Madison, Wisconsin, any place ... any place in any state I can use them because they are dead. The virus is still alive but I can use them because the law says I can use them. That is wrong. Wisconsin, here has made it to where it is legal to use smelt providing they are preserved in a manner to prevent spoiling... With the smelt, for the most part, they are coming out of the bigger waters and positive waters and salt has not been proven scientifically to kill the VHS virus but yet everything looks good on paper that you can end up using the smelt. That is totally wrong. (A-S-7, bait dealer/aquaculture)*

Several respondents expressed the belief that regulations to address VHS were inadequate because of the fragmentation of authority over activities that could contribute to its spread. These activities include interstate commerce, intrastate commerce, recreational angling, commercial aquaculture, and international shipping, among others. Consequently, government agencies with authority over these activities include state agriculture agencies, state fish and wildlife agencies, USDA-APHIS, the U.S. Fish and Wildlife Service, and the U.S. Coast Guard.

*From what I have seen and heard, and this is very common in the last 20 to 30 years in our country in a lot of subjects - everybody it is like "hear no evil, see no evil, hear no evil." Everybody indicating they don't have adequate authority - that is somebody else's authority. I think that is reflected in the fact that we do have in natural resources and in other areas, we have scattered a little bit of authority in a number of pockets without saying this is where the buck stops. (A-S-6, angler)*

### **Fairness**

Past work has shown that perceptions about the acceptability of management decisions are strongly influenced by the perceived fairness of those decisions. The perceived fairness of decisions, in turn, is influenced both by evaluation of the decisions themselves (distributive fairness) and evaluation of the procedures used to make those decisions (procedural fairness).

Judgments about procedural fairness are influenced by a variety of factors including whether affected stakeholders are given the opportunity to voice their opinions about proposed decisions, whether responsible agencies are receptive to that input, whether that input has an influence on decisions, and whether the responsible agency's reasons for its decisions are persuasive.

Consequently, perceptions about the dialogue that contributed to the development of VHS regulations could have a critical influence on the willingness of agencies and organizations to comply with or help implement those regulations. In general, the state fish and wildlife agency staff members with whom we spoke believed that the quality of dialogue between the states about VHS was very good. Many of them referred to the important role that the Great Lakes Fish Health Committee plays in this dialogue.

*On the whole, I pretty much know what is going on around the basin because the Great Lakes Fish Health Committee works. I think that puts us in kind of a unique perspective in comparison to the rest of the U.S. I have constant contact with those other people. If I need something, I know who to go talk to easily. Our chiefs, I have been involved in many of those discussions, have been in close coordination on VHS issues... I recognize there are inconsistencies in the regulations but they don't particularly bother me as long as the agencies have all taken it serious and taken prudent steps. (A-AG-8, state fish and wildlife agency)*

The relationship between the state fish and wildlife agencies and APHIS is perceived to have been strained, however.

*And now you area getting into a rub where veterinarians are taking over a regulatory role telling aquaculturists how to raise their fish, how to move their fish and there is some resentment there. And certainly there was a lot of resentment when APHIS first rolled out the order and we told state agencies you can't move your fish out of the Great Lakes or move between states and there was a big uproar because those state agencies were moving fish back and forth as willy nilly ... and they didn't like an agriculture agency coming in and telling them how to do things. So, I think that there has been a disconnect or I wouldn't say an unwillingness, but certainly hurt feelings and some distance put between resource agencies and Department of Ag. (A-AG-18, APHIS)*

Many individuals associated with state fish and wildlife agencies maintained that APHIS had not adequately considered their input during their decision-making about how to address VHS.

*Yes, I think there are some issues for states' rights and the responsibilities we have in trying to work in handling a problem like this. And sometimes, at least, in this situation ... it seemed like APHIS came and they pretty much dictated what was going to happen with our involvement from the policy standpoint with the states...right from the front end. There was even some advice that was offered through the Great Lakes Fish Health Committee that was ignored, and right from the front end it really left some hard feelings between I think the state and federal responsibility. And it just wasn't a very cooperative situation at all. (A-AG-4, state fish and wildlife agency)*

*I think everyone in the Basin feels that APHIS went about the project in the beginning in a very poor, poor way. They came at it in a very dictatorial fashion and ...while the agencies have responded, they have not done so willingly and ...APHIS has not endeared itself to the state governments, provincial government, probably even the Canadian government, in the way in which they have acted throughout. Although they have gotten somewhat better through time ...APHIS lost a lot of capital with respect to interactions with the states with regards to this. So the states initially didn't like a lot of things ...APHIS was not willing to listen. And I think had there been good faith consultation ...between federal government and the state, leading up to the interim rule, I think the process would have gone a whole lot better... Meetings with APHIS ...the ones I have been in are typical bureaucratic statements and APHIS just sits there and listens. There isn't really meaningful dialogue... The arrogance of the APHIS personnel has been astounding in my view. The state has tried in some ways to reach out and begin dialogue after the interim rule came out and pretty much were told that APHIS was going to do what it wanted to do. Yet, simultaneously we were also told that APHIS doesn't have the ability to enforce any of these regulations and they are going to rely on the states for enforcement. Well, you know that goes over like a lead balloon. And so, states even though they have done regulations and implemented regulations, quite frankly they don't really care about enforcing these regulations. And I think when they do care it is because they see value ...They are trying to do the best they can given the fact you've got the federal gorilla leaning over them saying that we've got to do something. (A-AG-5, state fish and wildlife agency)*

*We were already a member of the Great Lakes Fish Health Commission and I have been impressed from day one. I attended the first meeting along with our representative and the professionalism at how these guys are all health fish guys and they all leaned to the very conservative side of fish health. And, even with that, you know that wasn't taken into consideration. We didn't think they got proper notification and they were not referenced ... when they were asked for a lot of information that they had available. (A-AG-1, state fish and wildlife agency)*

Some individuals outside of state government also maintained that APHIS had not adequately consulted the states.

*So the initial response was big time overkill. Just to shut everything down after obviously not doing their homework. You know, there are eight states involved and they could have made eight phone calls to eight competent state authorities and in the course of less than a week, they would have known what the testing standards in the various states were. But they didn't and that was one of the big complaints from the state competent authorities, that APHIS really had not engaged them at all prior to inviting them to this meeting... So that set up a very adversarial mode right from the get go between APHIS and the state agencies. The state agencies felt that you know APHIS had overstepped their bounds ... and for the producers in the Great Lake states created an absolute economic disaster. (A-S-13, aquaculture)*

One perceived consequence of this lack of dialogue was the feeling that APHIS did not adequately consider the actions already being taken by others to address VHS.

*They are part of the Great Lakes Fish Health Committee which operates under the Great Lakes Fishery Commission, and they have had this intact organization for years, and it is a tightly controlled program...Our industry aquaculture worked with our vet school ...to test for all these major disease concerns that were put out by the Great Lakes Fish Health Committee. It was almost like disbelief ...it didn't mean anything anymore. (A-AG-9, Sea Grant)*

On the other hand, one state agriculture agency staff member was highly critical of the efforts state fish and wildlife agencies had underway to address VHS. He criticized them for the same shortcomings the state fish and wildlife agencies saw in APHIS – an unwillingness to adequately consider input from others interested in and affected by VHS.

*Not only are we very active but our agency is responsible for fish health and issues that are really critical in terms of movement of fish and pathogens ... However, we don't have a seat on the Great Lakes Fish Health Committee because we are not a resource agency. Now, in our view, if you have a group that represents the region you would have people like us as equal voting members on the committee and despite petitions over the years and numerous of times, there hasn't been any effort to do that. So, frankly it ends up being a ... more narrow scope and that's fine for the resource agency aspect. But what they are missing are the ag agencies and also the commercial sector. And so when they put together rules or recommendations, it is easy to imagine players in this region that*

*are not participants in the process are not going to put a lot of attention to it. We are not going to change our requirements if we are not having input in the process... And actually, it is very relevant to VHS in that one of the first responses that came out of a number of those from the Great Lakes Fish Health Committee when USDA directly responded to the VHS region: "Wait a minute, you don't need to do this. We've got things worked out. We've got coordination. We've got a plan." And in our opinion, there never was a plan that really would address this issue. There never was coordination or cooperation with all of the players in VHS. And quite frankly, I think it provided a reasonable justification for APHIS to step in...In fact, the counterparts in other regions looked at what had been developed and said, you know, we are not confident that this addresses the concerns of reducing the risk of the virus spreading, APHIS we're going to need you to step in because these folks don't have their house in order. (A-AG-20, state agriculture agency)*

Several interview respondents pointed out that the different, but overlapping, authorities of the agencies was one source of the tension between them.

*And I think part of that tension is because APHIS is looking to regulate aquaculture and I think most of the states spend most of their time thinking about regulating over the waters. Those are two very different perspectives in regard to regulation. I think APHIS looked to protect its aquaculture facilities by trying to stop the spread in the lakes. I think those of us who deal with open lake systems recognize the futility of trying to regulate a very stringent way in open systems. (A-AG-5, state fish and wildlife agency)*

Some respondents suggested that the relationship between the states and APHIS may be improving.

*I am hopeful ... I think they are learning. They got singed one more time and at least are smart enough this time not to run the new rule right out the door again. They are trying to take a thoughtful approach and they are asking questions. They are asking us some pretty good questions to try to fill in some of the information gaps so I think at least the document will have some sound reasoning. (A-AG-8, state fish and wildlife agency)*

Representatives of the aquaculture and bait industries had very similar perspectives on APHIS' decision-making process. A number of these individuals argued that their input was not adequately considered by APHIS before it began making its decisions.

*Well, along comes October of 2006 ... and there is a meeting scheduled in Washington, DC of concerned entities, you know, to talk about appropriate response to VHS. And I had gotten that information from the National Aquaculture Association and booked a flight, planned to attend and we were ready to go and we were going to talk about finally what kind of a response we are going to have at this meeting. And then of course, just before the meeting, APHIS roles out the emergency order, which is a great tactic if what you are trying to do is create emergency that will make people react and do things. (A-S-13, aquaculture)*

*It was very one-sided. You know like I said before, we totally got the shaft on this whole deal. We didn't have no say and what we did say, I don't think they heard. I don't think they got the gist of it. And it has been two years now and now their general issue is well it is working...but it is killing me. I am just about out of business...But it is working don't worry about it. (A-S-2, wild bait)*

The perceived lack of dialogue with states and industry were believed to lead to a couple of specific shortcomings in APHIS' regulations. First, some respondents maintained that APHIS did not adequately consider the impact of its regulations on affected stakeholders.

*On the APHIS side ... when I saw that they said an in-depth study to determine that this was the best rule and you read through the actual rule, I felt like they didn't really do a good evaluation of the industry. And I talked with the industry and none of them were contacted by APHIS to determine if this was going to be an economic impact on their business. The one thing I will say that ... APHIS did after the rules were released ...send in their chief scientist to a conference in Wisconsin which was very well attended by aquaculture people out west. He came there and he addressed questions to all these producers who were very angry, and he did an excellent job and ...basically told them the facts. This is what you have to do to change this and let them know exactly what had to happen and very impressed that he did. (A-S-9, aquaculture)*

Some also believed that APHIS was unaware of the steps already being taken by the aquaculture industry to address the threat of VHS.

*Even though we are already doing what is and has been deemed responsible since. We haven't changed our testing procedures. We are doing the same thing we have always done, but we were economically damaged because APHIS had failed to do their homework and it failed to recognize that there were producers like us that were doing exactly what they would have wanted us to do, and that is to test our facilities on a regular basis to make sure that there was no VHS. (A-S-13, aquaculture)*

This concern continued up through the publication of the proposed interim rule in the fall of 2008.

*Now, of course this was all in done in this big black box they couldn't send it out to anybody [and] say ... we had this idea about thirty day testing thing, do you see a problem with this? I could have saved them a whole lot of headaches if they have gathered some information and input and listened and listened to what the issues were but they didn't and so we had this train wreck. (A-S-13, aquaculture)*

*Well, I think they jumped the gun a little bit on some of the interim rules that came out. I know they wanted to do something and doing something is better than doing nothing, but they probably should have collected a little bit more input from probably the private sector more than anything. Although the beginning of just basically doing ... once a year, that actually, I think went over pretty smooth. The last one like I say, the November 10th one, that one didn't go over well...That was just a little bit too stringent on*

*especially the aquaculture end, so I think that one they could have thought about a little bit more. (A-S-17, aquaculture)*

On the other hand, one individual maintained that these preexisting efforts by industry and the states were insufficient to address the threat of VHS.

*And, a lot of these ideas sound really good but you will find that in some cases you'll have people saying ...they've got a biosecurity plan. But what does that mean? Well, we've actually incorporated into our rules ...that farms can partition their farm ...have an area where they are bringing in wild fish ... We allow that within our rules, but it also involves having an inspection done on those hatcheries to see if they are meeting the requirements... And if they don't meet the requirements ... it leads to higher level of testing. (A-AG-20, state agriculture agency)*

One representative of the bait and aquaculture industries even argued that the industry should have been prepared for this type of regulation.

*They are just too many people think that this is just being shoved down their throats. I think that is kind of narrow minded. As I said invasive species in the United States is not anything new. If they weren't preparing for this eventuality or at least seeing this eventuality ten years ago, to me it is kind of short-sighted. You have to look to the future. You can't look at it on a year to year basis. (A-S-4, wild bait/aquaculture)*

Concerns about the decision-making process were closely related to concerns about the decision itself. One argument made by a number of respondents was that the costs of the regulations were being borne by the aquaculture industry, even though the aquaculture industry was not primarily responsible for the spread of VHS.

*I am talking about our aquaculture guys ...You know they run their biosecurity stuff. They have certified facilities. They have been doing disease certification for years, including looking for VHS which they never found any. This thing came in, and it is like everybody is pointing a finger them ...All this responsibility is being thrown on them and all the expense. (A-AG-9, Sea Grant)*

*Just hard to understand where they are coming from. They find this in the Great Lakes, which is OK. That's in the wild. And the first people they come to and come down on like a sledge hammer is the small industry of aquaculture and now it seems like they want us to control it. Where is the reasoning for this? ... To do to an industry what they seem like to they want to do to us, I can't see where they are coming from. (A-S-14, aquaculture)*

*I honestly don't think the industry is responsible for the spread. I can point to half a dozen other vectors that would be. I can show you the examples. (A-S-4, wild bait/aquaculture)*

*So what we have done is reacted very adversely in a knee jerk kind of situation where without the facts APHIS moved ahead. And I think they are really in a position where they have an awful lot of egg on their face because we are in an unprecedented situation where we are going into the third situation of an emergency order, which has never happened before. And the order was issued without a lot of substantial evidence. So, how this has all impacted us ... it's had a great impact on the industry because at a time when we need to further aquaculture and production, it's hampered those of us ... in the production even though we have never had any VHS in our facilities. (A-S-19, aquaculture)*

Respondents from APHIS also recognized that aquaculture is likely not a major contributor to the spread of VHS.

*I do recognize that initially we tried to come down like a hard fist and then when we stepped back and started looking at the real vectors, we recognized that probably we are hitting the aquaculture the hardest because that is where our authority is. But the reality is that the disease is in the wild and ... this spread as far as I can tell is being done not by aquaculturists but by other types of activities such as recreational fishing. And the reason I say that is ...it has spread to inland lakes in New York, Ohio, Michigan, and Wisconsin. Certainly, that's not by ballast water. I mean a ship is not going to go across land and then dump off their water. As far as I know no DNRs are stocking those lakes. What is really happening is people are taking the wild bait, go with their bait buckets and go fishing in those lakes... So we are putting the screws on aquaculture but yet the real risks are on other types of activities. (A-AG-18, APHIS)*

One bait dealer made the argument that the regulations did not adequately consider the different risks associated with the wild bait and cultivated bait industries.

*The regulations, the interpretations to where it is a felony moving a farm raised product across the state line... I believe that it is totally wrong and the Lacey Act should be thrown... If I move a cow across the state line, OK, you will get a ...warning or something. No real big deal. Now if you end up moving fish across the state line, you are talking a Lacey Act violation ... and that is wrong. If you are talking wild fish, you are gill netting walleyes out of Lake Ontario, taking them wherever and selling them, doing whatever with them, that is one thing, You are talking farm raised fish and that is wrong. (A-S-7, bait dealer/aquaculture)*

Several representatives of state fish and wildlife agencies also maintained that APHIS' regulations did not adequately consider the economic value of the recreational fishery in their decision making.

*The impact on the recreational fishery ...the importance [APHIS] placed on that fishery was so out of line with what it is really worth and the effect that this could have that was huge to us. Shutting down the availability of bait. (A-AG-1, state fish and wildlife agency)*

*There are lots of other things that should be considered not the least of which is that sport fishing in the United States is worth... Aquaculture is about a \$1.1-1.2 billion industry nationally - you know our fishery is worth up to \$4 billion...and the way they belittled or essentially minimized the effects of the economic activity of recreational fishing was not a bright move on their part. (A-AG-8, state fish and wildlife agency)*

Many respondents recognized that APHIS' regulations could not simply consider the Great Lakes states, but had to be responsive to other regions, too.

*I realize APHIS is responding to outside the Great Lakes Basin - catfish farms and such don't want VHS found in their neck of the woods. Inland lakes across the Midwest don't want VHS brought in on bait fish. (A-AG-6, tribe)*

*Well, I think the other factors that are driving it and folks like the Pacific Northwest Fish Health Committee - or whatever that group is that commented - the Pacific Northwest agencies and it is a whole consortium. Their comments came across after the interim rule that basically the rules weren't strict enough. They wanted more restrictions. Basically, they didn't want to see an ounce of fish flesh live or dead leave the Great Lakes. (A-S-13, aquaculture)*

In contrast, many also argued that the emphasis being placed on the interests of these other regions was unfair.

*I think part of the problem from our perspective is ...the process is being driven by the catfish farmers in the south United States and trout farmers in the west. And I think they are forgetting about the implications on all the other aquacultures in the country ...I am not a gigantic promoter of private aquaculture. Personally I could care less one way or the other, but I don't also want to see them necessarily attacked in some way that is disproportionate to their potential affect... The way they put these rules together really puts a whammy on them and potentially puts them in a competitive disadvantage, and I don't think that is right at all. I know that APHIS responds to this because I know for example [a particular aquaculture industry representative] is in their offices all the time ...and she really represents the catfish farmers and the trout fish farmers and she is unabashed about it. She says she is in their offices every day. (A-AG-8, state fish and wildlife agency)*

*The NAA and the bait industry in Arkansas put a lot of pressure on APHIS to respond to this because they did not want this virus - this deadly virus to move to the west coast and in effect the salmonid industry... They raise 26 million pounds salmonid trout a year. They don't want that virus there and I can't blame them, but the bottom line is they feared something and like Chicken Little, the sky was falling - and guess what? The sky is still there. There was an immediate response and a lot of political pressure was put on APHIS to make a move and they did. That move - how do you rescind it? ... You tell me why we are over two years on an emergency order because they can't come up with an interim order. It is simply because the facts aren't there. They don't know how to handle it. Had it been a true documented situation that deserved the attention that it has gotten,*

*it would be easy to come up with an interim and a final rule on it because you would be able to define it. (A-S-19, aquaculture)*

One bait dealer argued that the steps APHIS has taken probably were necessary to stop the spread of VHS.

*When it first came out, I said here it is, the same old government crap - you know the minnow from Lake Michigan swims to Lake Erie and from Lake Erie to Toledo, from Toledo to Erie and Erie to Buffalo... But the thing is the disease is more I guess in ... some areas. It has been highly tested positive... Why transport that highly positive minnow to another area of the Great Lakes? That's what I guess we kinda come to accept that... We have adapted. So, I don't know - in my opinion I am not in favor of them dropping those border lines because I think it could come up and bite us in the ass... Being that it is so dominant in New York in that cold water I think you are just asking for more trouble. (A-S-10, bait dealer)*

### **Necessary Changes**

A variety of arguments were made about necessary changes to VHS regulations – both at the state and federal level. First, numerous interview respondents pointed to the need for greater coordination among agencies in their response to VHS. The number of states involved in these efforts is perceived to create considerable regulatory complexity.

*And if you combine the states that have come up with their own emergency rules, and that included seven or eight other pathogens along with VHS, and treated them as emergencies, you know that is just not the environment for selling fish interstate. It's really harmed commerce in this country when it comes to moving live fish. There are people going out of business and there are people who have gone out of business, people in business who are struggling. (A-S-18, aquaculture)*

In addition, authority over the disease is often divided between state agriculture and fish and wildlife agencies, and this division has led to confusion.

*The two agencies ...didn't like each other ... If one said one thing, the other said another. And then one would say we don't have to test for this and the other would say we are going to make you test for this. We don't want to test. We will make you test. Yes, in the long run we really got between the two state agencies. The biggest thing is if they would have worked together, it would have been fine I think. We would have gotten through it a lot better, a lot easier. ... I never really knew why they didn't get along... I think the biggest thing was control. I think from what we got out of it all the meetings we talked to them here and there both Department of Ag and Nat. Res. - it seemed like they both wanted control of the industry and neither one could get control so they pushed their weight in it as far as they could to see who could control what. (A-S-2, wild bait)*

*Fish and Wildlife and APHIS - both federal agencies. OK, who's in charge of movement of fish? Perfect example. Is it APHIS or is it Fish and Wildlife? ...If I break an APHIS*

*rule, is it Fish and Wildlife, or is it APHIS? You know, that is what is going on. From the state agencies you got - who is in charge of fish health? Is it the Conservation Department or is it the Ag Department? And you can go either way... Some of the states it is the DNR Conservation Department and some it is the Ag Department. And you know - we are in charge, no we are in charge. Back and forth they go - so who do you go to, to get answers. (A-S-7, bait dealer/aquaculture)*

Both government agency representatives and affected stakeholders made the argument that greater coordination between states was necessary.

*We are planning some workshops that will be dealing with this whole regulatory inconsistency among the states. One of the big areas that is a concern to us is ... we would like to see more consistency among the states because when you are trying to implement regulations ... it is a problem. (A-AG-12, state fish and wildlife agency)*

*There are some issues ... about interstate transport of fish and bait and things like that. It makes it difficult on those operators to try to do their business because regulations differ from New York to Pennsylvania to Ohio to Michigan and that creates regulatory and law enforcement headaches on the governmental side and creates huge business headaches... So, in the end, if we want to produce regulations that are effective in slowing the spread of the disease, really what happens is we put a patchwork out there with a lot of holes. There is a great opportunity for all sorts of loopholes to be exploited. So, are we really doing anything to slow the spread of virus? Unclear, you know. And so I think there is frustration there and I think within the fishery agencies ... it is a concern to try and look at ways...to become more consistent across the basin. (A-AG-5, state fish and wildlife agency)*

*This is ludicrous to me. It really is. Certain things I understand are out of our control, and we do our best to contain it, but when you have three other states and you have another country involved and they are all not doing the same thing, it makes us here in New York State and specifically in western New York, under a hell of a lot more pressure economically... We're taking the brunt of it all. And that is basically what we are trying to do is protect our fishery. People come down here and understand and take a look at the economy because the economy has a lot to do with it. And are we really stopping it? (A-S-8, angler)*

Several respondents thought that this coordination role would be a suitable role for APHIS to play.

*I felt like rather than just have a heavy regulatory role, I thought there was a coordination role that APHIS had in trying to come up with a very functional consolidated effort. And I think they felt like their role was just to come in and dictate that these were the guidelines to follow ... and that really ... left ... some inconsistencies in how the states have been involved with it. That has really made things difficult... There was another supporting role they had to help to make this thing work together a lot better and easier than what they took. (A-AG-4, state fish and wildlife agency)*

*When this VHS issue came up what it did was kind of prodded and stimulated states that didn't even have health requirements to jump on the band wagon to where we've got unreasonable requirements that are unprecedented that really ...make little or no sense. APHIS dropped the ball there. What should have been done if you are going to throw in an emergency quarantine on us ... is give us some guidelines. Say this is what we recommend. We can't tell you that you must do this, but this is what we recommend that the state adopts that you can continue to move your livestock - rather than a hodge podge of multiple standards try to go with a single standard so you can continue to move... I think Wisconsin changes their regulations almost on a weekly basis ...And you folks in New York - you have killed your industry. (A-S-18, aquaculture)*

Respondents also argued that regulations should correspond to watershed boundaries rather than political boundaries.

*The federal rule follows state boundaries, state boundaries rather than watershed boundaries, so we have very large parts of some of the states in which fish cannot be shipped out of state when they are not in the area exposed to VHS...I think it would be better if I made an example. Emerald shiners in Lake Erie are a very popular bait minnow and we cannot bring them from Buffalo, New York to Ohio anymore to use in Lake Erie. In other words, we can't catch them out of Lake Erie waters to use them in Lake Erie water. We cannot buy shiners from an Ohio bait store and go across the nearby Michigan line into Lake Erie waters. This is prohibited. Yet, the Ohio River which we assume to be uninfected ...prior to Ohio's quarantine zone ... you could take these shiners out to Cincinnati and use them on the Ohio River tributaries - turn them loose. So, we needed these more rationally developed boundaries rather than state boundaries. (A-AG-16, Sea Grant)*

*Well, first there is a real serious problem in that it immediately creates winners and losers and people who benefit and people who are harmed. As soon as APHIS came out with their Federal order they branded all the Great Lakes states as VHS positive. We have a lot of farms on the Delaware River drainage in Pennsylvania - and this is repeated throughout every state - there are border areas and border streams and rivers and watersheds that are far from the Great Lakes. So, just as an example, the eastern part of Pennsylvania drains into the Delaware River. The Western part of New Jersey, who is not a Great Lakes state, drains into the Delaware River. The farms on one side are required to spend the money to do the testing which is one cost that puts farms on the other side the river doesn't have. Probably the bigger thing with the federal order is that those farms were branded from a VHS positive region. And so they are, basically, on a black list. So now if you are buying fish from a farm and states are telling people don't buy fish or be cautious about buying fish from these states based on APHIS' orders. Well, scientifically there is no way to show that the farm on the one side of the river is any more a risk than the farm on the other side of the river. Yet, the farm on the Jersey side has been given a greater economic advantage... So that is really an irrational restriction on trade in my opinion. (A-S-18, aquaculture)*

*In Minnesota all of ... the VHS affected waters flows away from the state currently. I don't believe that Minnesota should be - I can see putting a 50 or 100 mile quarantine around the lakes but putting on the entire state is rather redundant because ... fish don't come from that area of the state into the rest of Minnesota. (A-S-4, wild bait/aquaculture)*

Finally, a variety of respondents argued that VHS regulations would be more logical and effective if they were framed within the broader context of the efforts to control the spread of invasive species.

*I think the good thing about the education materials that states have provided to anglers is that control of VHS that the mechanism by which you help prevent the spread is very similar to what anglers have done for zebra mussels ...bleach your live wells, dispose of live bait, don't release ballast back into the water. They have heard this message before and I think that is a good thing. (A-AG-5, state fish and wildlife agency)*

*DNR has one thing ...but it is very convoluted and rather confusing. Personally, I prefer that they just kind of handle it like we do with invasive species - dispose of your bait and don't carry bait from one water body to the next... I think the message consistency could probably be improved... Because basically if you do the same thing for VHS that we have people do for zebra mussels, you pretty much stop it... That has gotten terribly convoluted with the DNR regulations. (A-AG-15, Sea Grant)*

## **Information Sources**

Out of the 43 interview respondents, 39 answered questions regarding their sources of information about VHS. The characteristics of these 39 individuals are summarized in Table 3.

Table 4 lists the percentage of respondents who relied on various sources of information. Our respondents relied much more on expert sources of information (e.g., agencies and organizations) than popular sources (e.g., newspapers and magazines). Both federal and state agencies were important sources of information about VHS. Among federal agencies, USDA-APHIS (which regulates some activities that may contribute to the spread of VHS) and the U.S. Geological Survey (particularly the Western Fisheries Research Center, where research on VHS is conducted) were particularly important sources of information. At the state government level, both fish and wildlife agencies and agriculture agencies were mentioned frequently as sources of information. The Great Lakes Fishery Commission, which works closely with state and provincial fish and wildlife agencies, was also regularly mentioned as a source of information. Other common sources of information included several universities (with Cornell University mentioned most frequently), the state Sea Grants, and several organizations associated with the aquaculture industry. Respondents actively sought information both from individual contacts with these organizations and from the web sites these organizations maintained. Some respondents also conducted their own research on VHS using the internet or scientific literature.

**Table 3.** Characteristics of interview respondents included in information source analysis.  
 (“Citizens” could be classified in more than one category in some cases.)

	<b>Number</b>	<b>Percentage</b>
<b>Government</b>	<b>13</b>	<b>33.3</b>
State Fish and Wildlife Agencies	8	20.5
State Agricultural Agencies	1	2.6
USDA-APHIS	1	2.6
National Park Service	1	2.6
Great Lakes Fishery Commission	1	2.6
Native Tribes	1	2.6
<b>Sea Grants</b>	<b>6</b>	<b>15.4</b>
<b>Citizens</b>	<b>20</b>	<b>51.3</b>
By state:		
NY	2	5.1
PA	3	7.7
OH	3	7.7
IN	1	2.6
IL	2	5.1
MI	2	5.1
WI	4	10.3
MN	3	7.7
By stakeholder group:		
Bait industry	8	20.5
Aquaculture industry	9	23.1
Charter boat industry	2	5.1
Recreational anglers	6	15.4

**Table 4.** Percentage of respondents using various sources of information about VHS.<sup>1</sup>

<b>Source of Information</b>	<b>Percentage</b>
U.S. federal government	66.7
APHIS	38.5
USGS <sup>2</sup>	17.9
USFWS	10.3
Other USDA <sup>3</sup>	7.7
NOAA <sup>4</sup>	5.1
EPA <sup>5</sup>	5.1
Natural Resources Canada	2.6
State fish and wildlife agencies	64.1
State fish and wildlife agencies (in own state)	35.9
State fish and wildlife agencies (in other states)	20.5
NY	5.1
PA	7.7
OH	10.3
IN	5.1
IL	7.7
MI	15.4
WI	12.8
MN	5.1
State agricultural agencies	28.2
State agricultural agencies (in own state)	17.9
State agricultural agencies (in other states)	2.6
PA	7.7
OH	2.6
IN	2.6
WI	10.3
MN	2.6
State Legislatures	2.6

(Continued on next page.)

<sup>1</sup> In some cases, respondents only identified general categories of sources (e.g., “universities”) while in others they identified specific sources (e.g., “Cornell University”). Percentages for each category of sources include both those who identified specific sources within that category and those who identified only the general category.

<sup>2</sup> Primarily Western Fisheries Research Center.

<sup>3</sup> Primarily North Central Regional Aquaculture Center.

<sup>4</sup> Primarily Great Lakes Environmental Research Laboratory.

<sup>5</sup> Includes Great Lakes National Program Office.

**Table 4.** Percentage of respondents using various sources of information about VHS.  
(Continued.)

<b>Source of Information</b>	<b>Percentage</b>
Regional Bodies	23.1
Great Lakes Fishery Commission	20.5
Great Lakes Fish Health Committee	10.3
Great Lakes Information Network	2.6
Sea Grants	17.9
OH	5.1
MN	2.6
Extension	2.6
Universities	33.3
Cornell University	17.9
Michigan State University	7.7
University of Arkansas Pine Bluff	5.1
Ohio State University	2.6
Nongovernmental Organizations	10.3
American Fisheries Society	5.1
American Veterinary Medical Association	2.6
World Organization for Animal Health	2.6
Aquaculture industry	20.5
National Aquaculture Association	5.1
Aquatic Livestock Alliance	2.6
Wisconsin Aquaculture Association	2.6
Commercial fishing industry	2.6
Shipping industry	2.6
Recreational anglers' organizations	2.6
Mass media	2.6
Literature	15.4
Internet	15.4

The sources of information and the number of sources of information differed for different groups of respondents (Table 5). Sea Grant staff members relied on the greatest number of information sources listed in Table 5 (with a mean of 4.3 sources of information each). Five of the information sources were used by at least 50% of Sea Grant staff members: universities, USDA-APHIS, other federal government agencies (which often were involved in research on VHS), other Sea Grant staff members, and the scientific literature. Sea Grant staff members thus appeared to be particularly well-connected to primary sources of information about VHS regulations and research.

State fish and wildlife agencies relied on the next greatest number of information sources (with a mean of 3.5 sources of information each). The two most common sources of information for fish and wildlife agencies, however, were other state fish and wildlife agencies and the Great Lakes Fishery Commission, which is closely affiliated with state fish and wildlife agencies. Although many state agency staff members relied on other sources of information, too, they appear to be less closely connected with outside sources of information than Sea Grant staff members.

Representatives of key stakeholder groups relied on fewer sources of information on average than agency and Sea Grant staff members. Individuals affiliated with the aquaculture industry relied on the highest mean number of categories of information sources (2.6) followed by members of the bait industry (2.4) and anglers (2.0). State fish and wildlife agencies were a particularly important source of information for these stakeholder groups, with more than 50% of the members of each group relying on these agencies for information. Aquaculture operators had other important sources of information as well, including USDA-APHIS and state agriculture agencies.

As reported earlier in this document, the level of compliance of the three key stakeholder groups with VHS regulations and recommendations was perceived to decrease from aquaculture operators (high) to bait dealers (variable) to anglers (low). The groups with a lower perceived level of compliance tend to rely on fewer sources of information and rely more exclusively on fish and wildlife agencies.

We calculated “closeness” for each of our respondents, a measure of how central individuals were in the network based on their information sources. High closeness values indicate that an individual operates in an information environment that is very similar to those of others within the network. We computed the mean closeness value for several key groups of respondents (Table 6).

The mean closeness values, which can range between 0 and 100, are high for all groups, indicating that most respondents had at least some overlap in their sources of information about VHS (although differences also existed). They are highest for state fish and wildlife agency staff members and lowest for representatives of other government agencies, indicating that “other” government agencies are the least well connected in this network, yet still with a fairly high connectedness.

It is important to remember that our interview respondents were selected because they were identified as key individuals within government agencies or stakeholder groups. Often, they had

**Table 5.** Percentage of respondents using various sources of information about VHS, by stakeholder group.

Source of Information	Stakeholder Groups							Total
	State F&W Agencies	Other Gov't.	Sea Grants	Citizens	Bait Industry	Aquaculture Industry	Anglers	
State fish and wildlife agencies	100.0	40.0	33.3	65.0	62.5	55.6	83.3	64.1
APHIS	37.5	20.0	66.7	35.5	25.0	55.6	16.7	38.5
Other federal government	37.5	60.0	66.7	25.0	25.0	11.1	33.3	38.5
Universities	37.5	40.0	83.3	10.0	12.5	22.2	0.0	28.2
State agricultural agencies	25.0	20.0	33.3	30.0	25.0	55.6	0.0	28.2
Great Lakes Fishery Commission	50.0	40.0	16.7	5.0	0.0	0.0	16.7	20.5
Aquaculture industry	25.0	20.0	16.7	20.0	25.0	33.3	0.0	20.5
Sea Grants	12.5	0.0	50.0	15.0	25.0	0.0	16.7	17.9
Literature	0.0	40.0	50.0	5.0	0.0	0.0	16.7	15.4
Internet	0.0	0.0	16.7	25.0	37.5	11.1	16.7	15.4
Nongovernmental organizations	25.0	20.0	0.0	5.0	0.0	11.1	0.0	10.3

**Table 6.** Mean closeness values, by stakeholder group.

	Mean Closeness
State Fish and Wildlife Agencies	85.4
Other Government	70.8
Sea Grants	77.7
Citizens	75.6
Bait Industry	75.1
Aquaculture Industry	75.1
Anglers	75.0

.

been involved in public deliberations about VHS regulations. Thus, they are likely to be a better informed and more actively engaged group than representative samples of anglers, bait dealers, or aquaculture operators. Consequently, their strategies for obtaining information may differ from the strategies used by other members of their stakeholder groups. However, these individuals also often served as conduits for information to other individuals, and so understanding the strategies they used to obtain information can help to inform communication strategies designed to reach the stakeholder groups to which they belong.

## **Conclusions**

Our findings regarding information sources have several implications.

- Because different groups rely on different sources of information about VHS, communication will have to occur through a variety of sources to reach all groups. If multiple organizations are communicating information about VHS, however, maintaining consistency in the messages communicated may be a challenge. It may be necessary or desirable for key organizations to coordinate their communication efforts.
- Because the Sea Grants maintain contacts with primary sources of information about VHS regulations and research, they appear to have the potential to serve as a conduit for information from these primary sources to other groups. Currently, however, only a minority of members of most of the groups we studied turn to the Sea Grants for information.
- Because state fish and wildlife agencies are the most commonly used source of information for several key stakeholder groups, they appear to be well-positioned to ensure that key messages about VHS reach these groups.

Despite the differences in information sources on which our respondents relied, we found many common beliefs about VHS among those we interviewed. Respondents in our study generally believed that VHS was here to stay in the Great Lakes system and were concerned about the potential effects of VHS on wild fish populations, recreational angling, hatcheries, and aquaculture. However, considerable uncertainty existed about how much of an impact VHS would ultimately have. In general, concerns have decreased as time has elapsed without dramatic impacts from VHS.

Many respondents were more concerned about the impacts of VHS regulations than about the impacts of the disease itself. The regulations are perceived to have had impacts both on the costs of doing business for aquaculture operations and bait dealers and on bait availability for anglers. Compliance with VHS regulations and recommendations was perceived to be: (1) fairly low among anglers; (2) inconsistent among bait dealers (with the perceptions of some that wild bait dealers were least likely to comply); and (3) high among aquaculture operations.

Our study was designed to identify those factors that influenced compliance. The Theory of Planned Behavior postulates three factors that can be important in influencing behavior: (1) attitude (or whether compliance is viewed as important); (2) perceived behavioral control (or whether compliance is viewed as feasible); and (3) subjective norm (or whether social pressure

to comply exists). In this context, our results suggest that compliance could be influenced both by attitudes and perceived behavioral control.

- The perceived importance of compliance could be limited by low awareness of or concern about VHS (particularly among anglers) as well as the perception that existing regulations would not be effective at limiting the spread of VHS.
- A perceived lack of enforcement of regulations may also influence how important stakeholders believe it is to comply with regulations.
- The perceived feasibility of compliance is influenced both by the high monetary costs of compliance for aquaculture operations and bait dealers as well as the perception that compliance might not even be logistically possible if APHIS' indefinitely delayed interim rule is adopted.

Social psychology literature demonstrates that compliance with regulatory decisions can also be influenced by the perceived fairness of these decisions and the processes used to reach them. In this study, we found that the fairness of VHS regulations and regulatory decision making were major concerns for many respondents.

Because this study was exploratory and relied on qualitative data collected from a relatively small number of individuals, we have described the range of responses to VHS but we can not make a quantitative assessment of the influence of these factors on compliance among different stakeholder groups. Future research could be designed to provide such a quantitative characterization using standardized surveys with questions informed by the results of this study.

In addition to the data we collected on factors influencing compliance, many respondents also discussed changes in the management of VHS that they believed were necessary. Virtually all assumed that the management of VHS through regulations and education would continue to evolve, and many argued for greater coordination and cooperation between agencies during this process. Consequently, we think it is useful to also frame our results in relation to past findings of the literature on policy and management decision making.

Effective policy and management decision making has been portrayed as a learning process. The literature distinguishes several types of learning (Bennett and Howlett 1992, May 1992, Glasbergen 1996, Peterson 1997, Fiorino 2001, Lauber and Brown 2006) that occur in these contexts.

- *Technical learning* involves efforts to find new policies to accomplish existing objectives, but does not include reconsideration of the objectives. Although policies change, policy makers tend to rely on the same basic strategies. For example, regulators might change how frequently testing for VHS is required in order to improve efforts to limit the spread of VHS through aquaculture operations.
- *Conceptual learning* consists of the search for new objectives and new ways of defining the problem that is being addressed. As conceptual learning occurs, objectives are debated, the way people think about issues changes, and new concepts are developed. For example, agencies attempting to control the spread of VHS might shift from focusing

on the activities of aquaculture operations to the activities of anglers, shippers, or other groups.

- *Social learning* focuses on relationships between stakeholders and the quality of dialogue between them. It involves learning about how to promote effective communication and interaction. For example, state and federal agencies interested in the management of VHS might create an interagency task force to promote greater collaboration and coordination of VHS management efforts.

As management problems evolve, the type of learning that occurs is likely to change (Glasbergen 1996, Fiorino 2001, Lauber and Brown 2006). Technical learning tends to be the most common until problems are encountered that additional technical learning can not address. Conceptual learning (identifying new ways to define problems or new objectives) then lays the groundwork for additional technical learning. Social learning becomes necessary in situations in which agreement on objectives or problems that need to be addressed is not straightforward. Social learning then provides the foundation for conceptual and technical learning.

Our results suggest that social learning is an important need in efforts to address VHS. The authority to address VHS is divided between two countries, the federal and state level within the U.S., eight individual states, and both agriculture and fish and wildlife agencies. It seems impossible that any individual agency can achieve its management objectives working solely on its own. This perspective was reflected in the comments of many stakeholders.

It is widely believed, however, that interactions between key agencies involved in this work are characterized by poor relationships, lack of trust, and inadequate communication. The end result has been a lack of agreement about ends to pursue and means to pursue those ends. Without stronger agreement, it seems unlikely that efforts to manage VHS will widely be considered satisfactory. Social learning can contribute to policy making through improvements to relationships, dialogue, and interaction. These improvements then provide the foundation for reaching agreement about management ends and means.

## Literature Cited

- Ajzen, I. 1989. Attitude structure and behavior. Pages 241-274 *in* A. R. Pratkanis, S. J. Breckler, and A. G. Greenwald, editors. Attitude structure and function. Lawrence Erlbaum Associates, Hillsdale, NJ.
- Anderson, L. C., and D. R. Lee. 1986. Optimal governing instrument, operation level, and enforcement in natural resource regulation: the case of the fishery. *American Journal of Agricultural Economics* 68:678-690.
- Bennett, C. J., and M. Howlett. 1992. The lessons of learning: reconciling theories of policy learning and policy change. *Policy Science* 25:275-294.
- Bolek, D. D., and R. C. Hatfield. 2003. An investigation of the Theory of Planned Behavior and the role of moral obligation in tax compliance. *Behavioral Research in Accounting* 15:13-38.
- Elliott, M. A., C. J. Armitage, and C. J. Baughan. 2003. Drivers' compliance with speed limits: an application of the Theory of Planned Behavior. *Journal of Applied Psychology* 88:964-972.
- Fiorino, D. J. 2001. Environmental policy as learning: a new view of an old landscape. *Public Administration Review* 61:322-334.
- Glasbergen, P. 1996. Learning to manage the environment. Pages 175-193 *in* W. M. Lafferty, and J. Meadowcroft, editors. Democracy and the environment: problems and prospects. Edward Elgar, Brookfield, VT.
- Hatcher, A., S. Jaffry, and O. Thebaud. 2000. Normative and social influences affecting compliance with fishery regulations. *Land Economics* 76:448-461.
- Knuth, B. A., N. A. Connelly, and M. A. Shapiro. 1993. Angler attitudes and behavior associated with Ohio River health advisories. Human Dimensions Research Unit, Department of Natural Resources, Cornell University. Report 93-6.
- Lauber, T. B., and T. L. Brown. 2006. Learning by doing: policy learning in community-based deer management. *Society and Natural Resources* 19:411-428.
- Lauber, T. B., and B. A. Knuth. 1997. Fairness and moose management decision-making: the citizens' perspective. *Wildlife Society Bulletin* 25:776-787.
- \_\_\_\_\_. 1999. Measuring fairness in citizen participation: a case study of moose management. *Society and Natural Resources* 11:19-37.
- Lind, E. A., and T. R. Tyler. 1988. The social psychology of procedural justice. Plenum Press, New York.
- Lumsden, J. S., B. Morrison, C. Yason, S. Russell, K. Young, A. Yazdanpanah, P. Huber, L. Al-Hussine, D. Stone, and K. Way. 2007. Mortality event in freshwater drum *Aplodinotus grunniens* from Lake Ontario, Canada, associated with viral haemorrhagic septicemia virus, Type IV. *Diseases of Aquatic Organisms* 76:99-111.
- May, P. J. 1992. Policy learning and failure. *Journal of Public Policy* 12:331-354.
- McComas, K., L. S. Tuite, L. Waks, and L. A. Sherman. 2007. Predicting satisfaction and outcome acceptance with advisory committee meetings: the role of procedural justice. *Journal of Applied Social Psychology* 37:905-927.
- O'Boyle, C. A., S. J. Henly, and E. Larson. 2001. Understanding adherence to hand hygiene recommendations: the Theory of Planned Behavior. *American Journal of Infection Control* 29:352-360.

- Peterson, M. A. 1997. The limits of social learning: translating analysis into action. *Journal of Health, Politics, Policy and Law* 22:1077-1114.
- Smith, P. D., and M. H. McDonough. 2001. Beyond public participation: fairness in natural resource decision making. *Society and Natural Resources* 14:239-249.
- Sutinen, J. G., and K. Kuperman. 1999. A socio-economic theory of regulatory compliance. *International Journal of Social Economics* 26:174-193.
- Tuler, S., and T. Webler. 1999. Voices from the forest: what participants expect of a public participation process. *Society and Natural Resources* 12:437-453.