MICHIGAN STAKEHOLDERS' PERCEPTIONS OF RISK FROM FISH DISEASE (VHS) AND TRUST IN AGENCY MANAGERS: ASSESSMENT USING THE ZOONOTIC DISEASE RISK INFORMATION SEEKING AND PROCESSING (ZDRISP) MODEL AND MESSAGE TESTING USING GAIN AND LOSS FRAMING

By

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ABSTRACT

MICHIGAN STAKEHOLDERS' PERCEPTIONS OF RISK FROM FISH DISEASE (VHS) AND TRUST IN AGENCY MANAGERS: ASSESSMENT USING THE ZOONOTIC DISEASE RISK INFORMATION SEEKING AND PROCESSING (ZDRISP) MODEL AND MESSAGE TESTING USING GAIN AND LOSS FRAMING

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One threat to fish populations, and the main focus of this thesis study, is fish disease. Fishery agencies and Michigan residents have justification to be concerned about this issue as they can create a large impact on the health of fish populations and are the cause of many fish deaths. Part A of this thesis research expanded and tested attributes of a Zoonotic Disease Risk Information Seeking and Processing (ZDRISP) model adapted to an aquatic context using a fish disease, viral hemorrhagic septicemia (VHS), as a case study (Clarke, 2009; Triezenberg, Gore, Riley, & Lapinski, 2014a). Part A investigated participants' risk perceptions of VHS and its management as well as their trust in management. Results from Part A informed the creation of gain and loss outreach messages to be tested in Part B of the research. Gain and loss framing has been used as a technique in risk communication to shape individuals preferences or actions in many fields, especially health communication, but has also been studied in other contexts– including environmental actions. Part B tested five outreach messages and was conducted in partnership with the Michigan Department of Natural Resources (MDNR) Fisheries Division and Michigan Sea Grant Extension through the Michigan State University Graduate Certification in Community Engagement program. Overall, this thesis research provides support for further testing of the ZDRISP model and insights for fisheries agencies to effectively communicate about fish diseases in a broader context.

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CHAPTER 1

INTRODUCTION AND LITERATURE REVIEW

One threat to fish populations, and the main focus of this thesis study, is fish disease. Fish diseases, such as whirling disease, largemouth bass virus (LMBV), bacterial kidney disease (BKD), and furunculosis, not only affect fish of the Great Lakes region, they are found worldwide in both the natural and hatchery environments (Faisal et al., 2013; Indiana Department of Natural Resources, 2005a, 2005b). Some fish diseases are zoonotic, meaning that they can be transmitted from wildlife or fish to humans and may have human health impacts. Two widely-known zoonotic diseases with human health implications are Lyme disease and rabies (National Center for Emerging and Zoonotic Infectious Diseases, 2012). Many emerging diseases today are zoonotic in origin; for example, Ebola, which was transmitted to humans from hunting and butchering infected chimpanzees and gorillas (Machalaba, 2014). Although they do not have similar risk factors as wildlife zoonoses, fish zoonoses include bacteria and parasites that can infect humans through consumption and handling (Nemetz & Shotts Jr., 1993). Most illnesses can be avoided by following best practices of handling and preparation and overall there is a low occurrence of fish-related cases in the U.S. (Nemetz & Shotts Jr., 1993).

While they generally do not pose a great risk to humans, fish diseases pose a risk to the environment, fishing, and the culture of fishing. Fish diseases that are not zoonotic and occur within fish populations are contracted by all kinds of fish and have many types of causes, including bacteria, fungi, parasites, and viruses. Fishery agencies and Michigan residents have justification to be concerned about this issue. Some fish diseases can

create a large impact on the health of fish populations and are the cause of many fish deaths, which in turn impacts the ecosystem the fish exist in.

Research Overview

This thesis research aims to identify what aquatic based recreational users believe are risks from fish disease and how their individual levels of trust in the MDNR Fisheries Division may influence their levels of concern about fish disease. In addition, it will also investigate any potential differences geographically, comparing the three VHS management area types in an area where they converge in Michigan. The research will also test what type of communication frame, gain or loss, is most effective for natural resource agencies in communicating fish disease risks to these users.

Literature Review

As a state with vast freshwater resources, Michigan is a haven for water sports and activities. These activities include canoeing, kayaking, boating, and recreational and commercial fishing. Within the Great Lakes states of Michigan, Ohio, Indiana, Wisconsin, and Illinois alone, paddling activities (kayaking, rafting, and canoeing) made a total economic contribution of 3.12 billion dollars in 2006– most expenditures being trip-related (Outdoor Industry Foundation, 2006). In Michigan in 2007, 28% of households kayaked and 20% of households owned a canoe or kayak (Zuzelski & McCole, 2012). Canoers in the United States tend to live in the states of Michigan, Wisconsin, Illinois, Indiana, and Ohio, comprising 24% of total U.S. participants for the activity (The Coleman Company & The Outdoor Foundation, 2015). In the U.S. there is also a trend of the specialization of kayak fishing (Zuzelski & McCole, 2012). Overall, participation in paddling sports is increasing in the United States, especially in kayak

fishing and stand-up paddling, with 17% and 26% growth from 2012-2015, totaling 2,265,000 and 3,020,000 participants in 2015, respectively (The Outdoor Foundation, 2016). The number of recreational boats, including powerboats, personal watercrafts, sailboats, and other boats totaled 771,439 in Michigan in 2012 (National Marine Manufacturers Association, 2012). Recreational boating-related spending in Michigan totaled 3.2 billion dollars in 2012 (National Marine Manufacturers Association, 2012).

Fishing is a popular activity in the Great Lakes states, which comprised 17% of the country's total fishing participants in 2013, closely behind South Atlantic states contributing 19.9% of total fishing participation (Recreational Boating & Fishing Foundation & The Outdoor Foundation, 2014). In Michigan, many residents of the state participate. In 2013, 978,067 in-state fishing licenses, tags, permits and stamps were sold in Michigan (U.S. Fish and Wildlife Service, 2013). Michigan had an estimated population of 9,922,576 in July 2015 (U.S. Census Bureau, 2016). These resident anglers represented almost ten percent of the entire state population (U. S. Census Bureau, 2014). Like paddle sports, recreational and sport fishing also make an impact on Michigan's economy. Anglers who fished in Michigan spent 2.4 billion dollars in 2011; expenditures which included trip-related purchases, fishing equipment, auxiliary and special equipment (boats, fishing clothing, etc.), and other purchases of licenses, magazines, land leasing, etc. (U.S. Department of the Interior, U.S. Fish and Wildlife Service, U.S. Department of Commerce, & U.S. Census Bureau, 2011).

The commercial fishing industry is very important to Michigan's economy. In 2013, commercial fishery production totaled over eight million pounds of fish and the dockside value was estimated at over fourteen million dollars (Michigan Department of

Natural Resources, 2013). After these fish are processed and sold, the economic impact is estimated at four to five times the dockside value (Goniea, 2014). The fish caught from the Great Lakes are sold by retailers, markets, and restaurants and consumed by residents all over the state and country. As participation in these aquatic-based recreational activities is a vital contribution to the economic activity within the state, it is important that fish health is considered as disease may threaten fishing activities by large fish mortality or making fish undesirable for consumption.

As fishing and other aquatic-based recreational activities are significant in Michigan, one fish disease of concern that has been addressed by regulations at the state and Federal levels for over a decade is viral hemorrhagic septicemia (Michigan Department of Natural Resources, 2016a). Viral hemorrhagic septicemia (VHS) is a fish disease caused by a virus and found in over 80 freshwater and marine species in the Northern Hemisphere (Faisal et al., 2012). Originating as a freshwater disease of trout in Europe in the 1930s, the disease was found in marine trout and salmon off the West coast of the U.S. in the late 1980s, and then in the early 2000s was detected off the East coast of Canada (Wisconsin Department of Natural Resources, 2015). VHS was first found in the Great Lakes region in 2005 (United States Department of Agriculture, 2006). The VHS virus (VHSV) has different genotypes found around the world, and genotype IV—found in different locations in North America– was the genotype discovered in the Great Lakes (Throckmorton, Peters, Brenden, & Faisal, 2015). There sublineages of genotype IV on the continent are: VHSV IVa in the Pacific Northwest, VHSV IVc in the North Atlantic, and VHS IVb in the Great Lakes (Throckmorton et al., 2015).

VHS can be found in many species of fish, all of a wide variety of genus, in the Great Lakes basin (Michigan Sea Grant, n.d.). About 16% of the total fish species in the Great Lakes are susceptible– of the 250 species of fish found in the basin, the MDNR lists 40 susceptible species (Great Lakes Environmental Research Lab, n.d.; Michigan Department of Natural Resources, 2016a). Susceptible fish species to VHS in Michigan include: Atlantic salmon (*Salmo salar*), black bullhead (*Ameiurus melas*), black crappie (*Pomoxis nigromaculatus*), bluegill (*Lepomis macrochirus*), bluntnose minnow (*Pimephales notatus*), brook trout (*Salvelinus fontinalis*) brown bullhead (*Ameiurus nebulosis*), channel catfish (*Ictalurus punctatus*), cisco (lake herring) (*Coregonus artedi*), common shiner (*Lulilus cornutus*), creek chub (*Semotilus atromaculatus*), emerald shiner (*Notropis atherinoides*), fathead minnow (*Pimephales promelas*), flathead catfish (*Pylodictis olivaris*), golden shiner (*Notemigonus crysoleucas*), green sunfish (*L. cyanellus*), hybrid sunfish (genus *Lepomis)*, lake trout (*Salvelinus namaycush*), lake whitefish (*Coregonus clupeaformis*), largemouth bass (*Micropterus salmoides*), muskellunge (*Esox masquinongy*), Northern pike (*Esox lucius*), Northern redbelly dace (*Chrosomus eos*), Pacific herring (*Clupea pallasi*), pumpkinseed (*Lepomis gibbosus*), rainbow smelt (*Osmerus mordax*), rainbow trout (*Oncorhynchus mykiss*), redear sunfish (*L. microlophus*), rock bass (*Ambloplites rupestris*), sand shiner (*Notropis stramineus*), smallmouth bass (*Micropterus dolomieu*), spotfin shiner (*Cyprinella spiloptera*), spottail shiner (*Notropis hudsonius*), walleye (*Sander vitreus*), warmouth (*Lepomis gulosus*), white bass (*Morone chrysops*), white crappie (*Pomoxis annularis*), white sucker (*Catostoma commersoni*), yellow bullhead (*Ameiurus natalis*) and yellow perch (*Perca flavescens*) (Michigan Department of Natural Resources, 2016a).

VHS affects many different species of fish, which have different human uses; for example, shiners or minnows as baitfish, muskellunge or Atlantic salmon targeted for sport fishing, or lake whitefish targeted for commercial fishing. In Michigan, the surrounding Great Lakes already have VHSV present, but inland waters are also at risk of becoming infected with the virus. Budd Lake in Clare County and Baseline Lake in Washtenaw County have tested positive for VHS since the virus entered the state (Michigan Department of Natural Resources, 2014c).

Many fish kills throughout the Great Lakes region in the mid 2000s, large and small, can be linked to VHS (Figure 1.1). Many of these kills have occurred in Lake St. Clair and Lakes Ontario and Erie, although kills have been found in other bodies of water around the region as well (Michigan Sea Grant, n.d.). To confirm VHS is the cause of a kill, laboratory testing must be conducted, as other fish diseases have similar symptoms (Minnesota Department of Natural Resources, 2015). VHS infections can be acute to chronic within a fish, with the symptoms depending on fish species, age, stress, environmental factors, and temperature (Faisal et al., 2012). The strain of VHSV found in the Great Lakes region, VHSV IVb, is most active in cold water that is less than 15 degrees Celsius (Michigan Sea Grant, n.d.). VHSV externally affects fish through hemorrhaging of the skin, although some fish may not exhibit any external symptoms (Michigan Sea Grant, n.d.). Internally, the virus causes organ damage via hemorrhages in the liver, spleen, and intestines (Michigan Sea Grant, n.d.). Death typically occurs because of organ failure, especially in the kidneys, or the inability to osmoregulate (Michigan Sea Grant, n.d.). Infected fish can show behavioral symptoms such as listlessness, swimming in circles, or staying just beneath the surface of the water

(Michigan Sea Grant, n.d.). Fish that survive the infection are carriers of the VHS virus and can infect other fish via feces, urine, and reproductive fluids (Michigan Sea Grant, n.d.).

Figure 1.1. Gizzard shad kill in Michigan's Lake St. Clair in 2006 (Faisal et al., 2012).

VHS is especially relevant to the fishing industry and fish consumers because it has the ability to produce large fish kills and can infect many different types of fish, including the Great Lakes region most commercially valued species, lake whitefish. Whitefish is really the mainstay of the commercial fishing industry in Michigan, with it being 85% of the volume and 90% of the value of the commercial fishery (Goniea, 2014). In addition, recreational fishermen also target the species. In the mid 2000s, small kills occurred in whitefish in Lake Huron (Michigan Sea Grant, n.d.). Michigan is known for its whitefish products and fish disease could potentially have a great negative impact on fishing and processing industries if large-scale mortalities occur.

As VHS first began to infect fish in the Great Lakes region in the mid-2000s, regulations were developed at both state and federal levels. In the United States, various agencies are responsible for different aspects of fisheries resources. For example, state commercial and recreational fishing regulations are developed and enforced by state governments. Other aspects, such as interstate commerce via the movement of fish, are under the jurisdiction of the United States Department of Agriculture's (USDA) Animal Plant and Health Inspection Service (APHIS) at the federal level. In addition to the Department of Natural Resources, and as a non-inclusive list, the following entities may play a role in the development of fisheries regulations in Michigan: the U.S. Fish and Wildlife Service (U.S. FWS) at the federal level, tribal authorities within a state, the Great Lakes Indian Fish and Wildlife Commission (GLIFWC) at a multi-state tribal level, and the Great Lakes Fisheries Commission (GLFC) at an international level between the U.S. and Canada.

In response to the detection of VHSV, at the Federal agency level, USDA APHIS issued an emergency VHS Federal Order in October 2006 that prohibited the movement of live susceptible fish species into the U.S. and interstate movement between the eight Great Lakes states (Animal Plant and Health Inspection Service, 2006). After a two-day meeting, APHIS revised the order in November 2006 to allow the movement of live fish of susceptible species from the Great Lakes states provided certain conditions were met (Animal Plant and Health Inspection Service, 2006). These conditions included, but were not limited to: proper USDA documentation for the movement of restricted animals, testing negative for VHS with the documentation from the appropriate State, Tribal, or Federal laboratories, and the treatment of fish waste fluids and water,

depending on what purpose the animal was being transported for– slaughter, research, or other purposes (Faisal et al., 2012). As of June 2014, APHIS has repealed the VHS Federal Order because of its similarity to existing state regulations and allowing the movement of live fish will benefit the aquaculture industry's necessary fish transports (Animal Plant and Health Inspection Service, 2014). APHIS deemed lifting the federal order as safe as long as states upheld their current VHS regulations and continued practices to reduce the risk of the virus (Animal Plant and Health Inspection Service, 2014). VHS remains listed on the World Organisation for Animal Health (OIE) OIE-Listed diseases, meaning it is still being reported if found (World Organisation for Animal Health, 2016).

Initial regulations when VHS was first found in the Great Lakes took a lot of precautions regarding baitfish. A study by Lauber et al. (2009) found that stakeholders from angler and aquaculture organizations as well as bait dealers in the Great Lakes states thought that VHS regulations had caused a lower availability of certain species of bait and that the lower availability had discouraged fishing and impacted fishing communities negatively (Lauber, Connelly, & Knuth, 2009). Today, there is an Aquatic Invasive Species Hazard Analysis and Critical Control Point (HACCP) course for addressing biosecurity issues, including pathogens. VHS was specifically targeted in eight workshops held in Michigan aquaculture facilities in 2014, by a partnership of agencies such as Michigan Sea Grant and Michigan State University Extension, and the baitfish and aquaculture industries, among others (Kinnunen, 2014).

In response to the discovery of VHS in the Great Lakes at the state agency level, Michigan had a regulation that baitfish sellers needed to provide, and anglers needed to

keep baitfish receipts. As of January 2014, MDNR announced the repeal of that regulation as anglers are now more informed about risks of using baitfish (Michigan Department of Natural Resources, 2014a). The baitfish regulations used in 2015 (using VHS management areas) are summarized below (Table 1.1). As regulations have changed and ceased the use of VHS management areas, this table is no longer used in the current 2016-2017 Michigan Fishing Guide.

Table 1.1. VHS management area regulations for bait (including baitfish or roe) use by harvest type (Michigan Department of Natural Resources, 2015a).

Bait Harvest Type	**Collected from VHS Positive Area**	**Collected from VHS Surveillance Area**	**Collected from VHS Free Area**
Personally Harvested Bait	Use restricted to Positive Area waters	Use restricted to Surveillance Area or Positive Area waters	Use allowed in all waters
Commercially Harvested or Purchased Bait – Uncertified	Use restricted to Positive Area waters	Use restricted to Surveillance Area or Positive Area waters	Use allowed in all waters
Commercially Harvested or Purchased Bait – Certified	Use allowed in all waters	Use allowed in all waters	Use allowed in all waters

To address VHS in Michigan waters, the MDNR created a Fish Disease Control Order for VHS, known as Fisheries Order 245 in 2007. MDNR identified VHS management areas— Positive, Surveillance, and Free— and each had different regulations in order to "protect the aquatic resources of the State, minimize the spread of Pathogens of concern to uninfected waters, and protect the Department's fish hatchery system" (Figure 1.2) (Michigan Department of Natural Resources, 2014b). In the positive management areas, VHS had already been detected and confirmed. In surveillance management areas, VHS had not been detected yet but it is highly likely

that the virus will be detected. VHS had not yet been detected in free management zones.

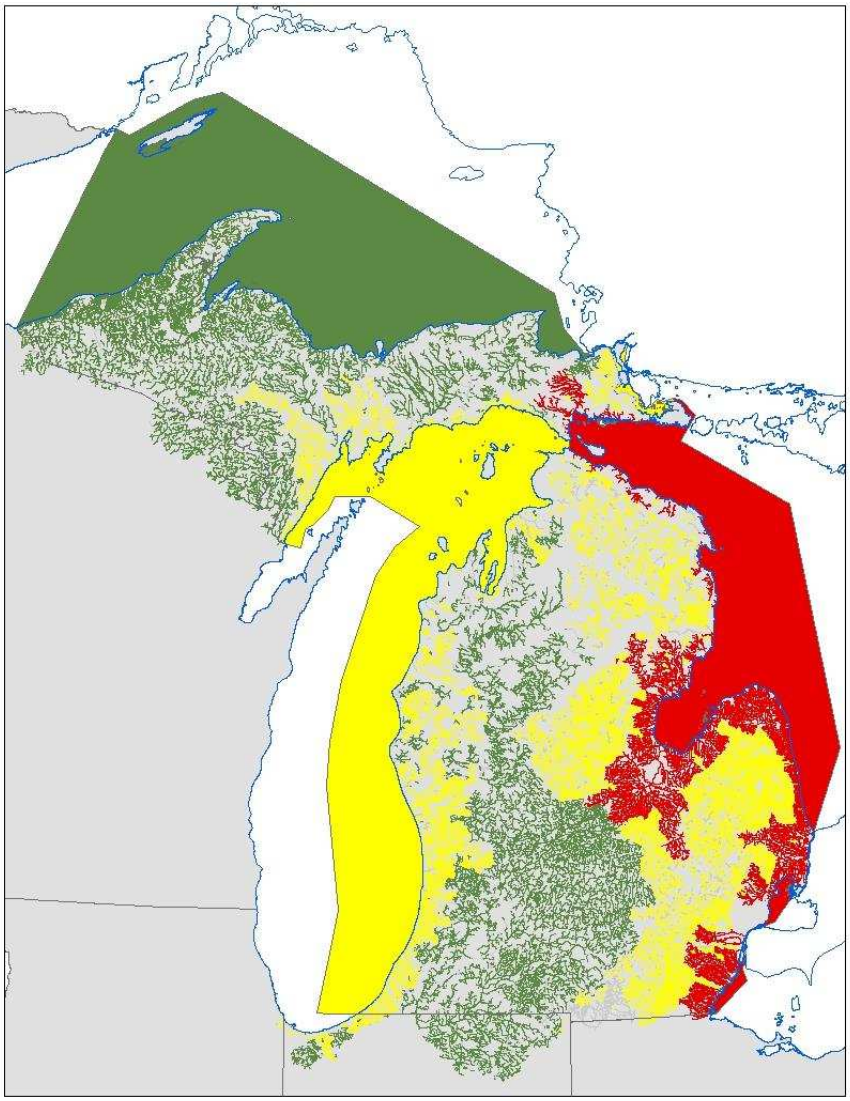


Figure 1.2. Map of MDNR VHS management areas from Klatt, Lupi & Melstrom (2014). VHS Free is in green, VHS Surveillance is in yellow, and VHS Positive is in red.

Regulation changes in Michigan affected the use of baitfish, transport of live fish, and draining of boats for both Great Lakes and inland waters. Management areas were used for VHS regulations in the Michigan Fishing Guide through 2015. In 2015 when the study began, the general statewide provisions for VHS regulation were:

1. “A person shall not stock baitfish, live fish or roe in public waters of the state prior to receiving a Fish Stocking Permit from the department and the permit must be in possession when transporting and stocking the fish. It is unlawful to import any uncertified baitfish species found on the list of Susceptible Fish Species.
2. Fish caught in a waterbody should only be released into the waterbody where originally caught and not transferred into another location where the fish could not have freely moved to.
3. A person shall not use or release baitfish in any public waters of the state, unless the baitfish are attached to a hook. Use of roe is restricted per the specific regulations outlined in the Management Area Regulations for Viral Hemorrhagic Septicemia virus (VHS).
4. A person who trailers a boat over land shall drain all water from the live well(s) and the bilge of their boat upon leaving any body of water” (Michigan Department of Natural Resources, 2015a, pp. 32-33)

During the study time period, through a partnered research project with MDNR, it was learned that Michigan regulations regarding VHS would likely be changing in 2016 (Walter, 2016b). The proposed revision of Fisheries Order 245 on February 16, 2016 included not only the removal of the VHS management areas, but also updating the list of VHS susceptible species, removal of the use of roe in exclusion zones, require bait harvested in the months of November and December to be certified as disease-free, require a test in five zones of the Lake Huron-Lake Erie Corridor, and require personally collected bait be used in the same water it was collected from (Michigan Department of Natural Resources, 2016f). This proposal was approved and the DNR released a press

release in April 2016, notifying citizens of those regulation changes as part of Fisheries Order 245 (Michigan Department of Natural Resources, 2016c). These changes are also reflected in the new, two-year fishing guide– a new approach for the MDNR Fisheries Division, as past fishing guides were valid for one year (see Figure 1.3).

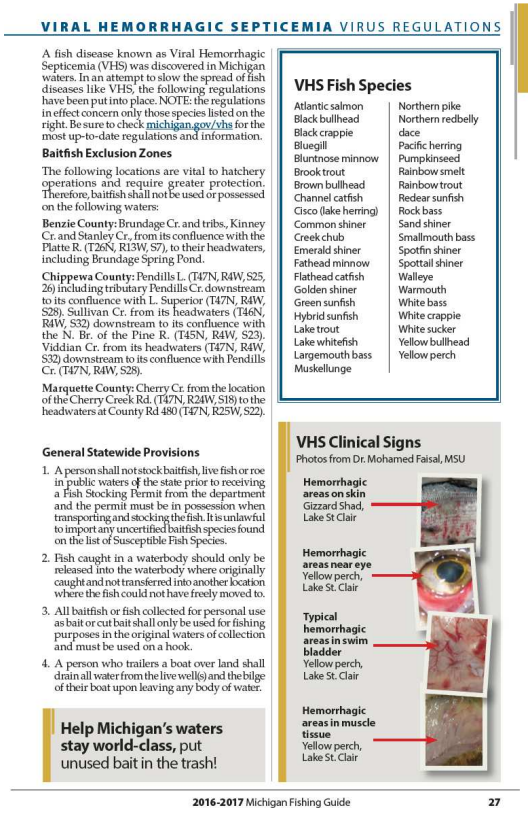
The 2016-2017 Michigan Fishing Guide states exclusion zones of using baitfish and roe in certain waters of three counties– Benzie, Chippewa, and Marquette– because of their importance to fish stocking (Michigan Department of Natural Resources, 2015a). These are the same zones that were used in the 2015 Fishing Guide. The exclusion zones located in Chippewa County are Pendills Lake, Pendills Creek, Sullivan Creek, and Viddian Creek, and is a county included in the study area (Michigan Department of Natural Resources, 2016a, p. 27).

The most current VHS general statewide provisions for Michigan, valid through March 31, 2018 are as follows:

1. "A person shall not stock baitfish, live fish or roe in public waters of the state prior to receiving a Fish Stocking Permit from the department and the permit must be in possession when transporting and stocking the fish. It is unlawful to import any uncertified baitfish species found on the list of Susceptible Fish Species.
2. Fish caught in a waterbody should only be released into the waterbody where originally caught and not transferred into another location where the fish could not have freely moved to.
3. All baitfish or fish collected for personal use as bait or cut bait shall only be used for fishing purposes in the original waters of collection and must be used on a hook.

4. A person who trailers a boat over land shall drain all water from the live well(s) and the bilge of their boat upon leaving any body of water" (Michigan Department of Natural Resources, 2016a, p. 27)

As mentioned previously, the change made to the general provisions most notably removed the use of the VHS management areas. Also, the regulations in effect in the 2016-2017 Fishing Guide concern only VHS Fish Species, which are also listed in the guide (Michigan Department of Natural Resources, 2016a, p. 27). The list now contains 40 species, compared to 33 in the 2015 Fishing Guide (Michigan Department of Natural Resources, 2015a, 2016a).



VIRAL HEMORRHAGIC SEPTICEMIA VIRUS REGULATIONS

A fish disease known as Viral Hemorrhagic Septicemia (VHS) was discovered in Michigan waters. In an attempt to slow the spread of fish diseases like VHS, the following regulations have been put into place. NOTE: the regulations in effect concern only those species listed on the right. Be sure to check michigan.gov/vhs for the most up-to-date regulations and information.

Baitfish Exclusion Zones

The following locations are vital to hatchery operations and require greater protection. Therefore, baitfish shall not be used or possessed on the following waters:

Benzie County: Brundage Cr. and tribs., Kinney Cr. and Stanley Cr., from its confluence with the Platte R. (T26N, R13W, S7), to their headwaters, including Brundage Spring Pond.

Chippewa County: Pendills L. (T47N, R4W, S25, 26) including tributary Pendills Cr. downstream to its confluence with L. Superior (T47N, R4W, S28). Sullivan Cr. from its headwaters (T46N, R4W, S32) downstream to its confluence with the N. Br. of the Pine R. (T45N, R4W, S23). Viddian Cr. from its headwaters (T47N, R4W, S32) downstream to its confluence with Pendills Cr. (T47N, R4W, S28).

Marquette County: Cherry Cr. from the location of the Cherry Creek Rd. (T47N, R24W, S18) to the headwaters at County Rd 480 (T47N, R25W, S22).

General Statewide Provisions

1. A person shall not stock baitfish, live fish or roe in public waters of the state prior to receiving a Fish Stocking Permit from the department and the permit must be in possession when transporting and stocking the fish. It is unlawful to import any uncertified baitfish species found on the list of Susceptible Fish Species.
2. Fish caught in a waterbody should only be released into the waterbody where originally caught and not transferred into another location where the fish could not have freely moved to.
3. All baitfish or fish collected for personal use as bait or cut bait shall only be used for fishing purposes in the original waters of collection and must be used on a hook.
4. A person who trailers a boat over land shall drain all water from the live well(s) and the bilge of their boat upon leaving any body of water.

Help Michigan's waters stay world-class, put unused bait in the trash!

VHS Fish Species

Atlantic salmon	Northern pike
Black bullhead	Northern redbelly dace
Black crappie	Pacific herring
Bluegill	Pumpkinseed
Bluntnose minnow	Rainbow smelt
Brook trout	Rainbow trout
Brown bullhead	Redear sunfish
Channel catfish	Rock bass
Cisco (lake herring)	Sand shiner
Common shiner	Smallmouth bass
Creek chub	Spotfin shiner
Emerald shiner	Spottail shiner
Fathead minnow	Walleye
Flathead catfish	Warmouth
Golden shiner	White bass
Green sunfish	White crappie
Hybrid sunfish	White sucker
Lake trout	Yellow bullhead
Lake whitefish	Yellow perch
Largemouth bass	
Muskellunge	

VHS Clinical Signs

Photos from Dr. Mohamed Faisal, MSU

Hemorrhagic areas on skin Gizzard Shad, Lake St Clair

Hemorrhagic areas near eye Yellow perch, Lake St. Clair

Typical hemorrhagic areas in swim bladder Yellow perch, Lake St. Clair

Hemorrhagic areas in muscle tissue Yellow perch, Lake St. Clair

Figure 1.3. VHS regulations in the 2016-2017 Michigan Fishing Guide.

Another current concern for managers is the persistence of the VHS virus in bodies of water, which has implications for fish stocking and creates the necessity of continuing efforts to prevent the spread of the virus. One inland lake in the Lower Peninsula of Michigan, Budd Lake in Clare county, where surveillance and free VHS management areas met, experienced fish mortality from VHS in May 2007 and tested negative for the virus in the following years of 2007 to 2010, yet tested positive in 2011 (Throckmorton et al., 2015). Throckmorton et al. (2015) posits that the virus has persisted in the lake, yet gone undetected. An alternative explanation for the positive test four years later is that other animals, vectors such as turtles and snakes, or invertebrates with the VHS virus in their tissues, have reintroduced the VHS virus strain to Budd Lake (Throckmorton et al., 2015). Another alternative explanation is the human transport of the virus (Throckmorton et al., 2015).

Although VHS is present in some bodies of water and not others, humans can transfer it from one body of water to another. The pathways VHS and other fish diseases are spread include moving infected fish and live bait from infected waters to other bodies of water, emptying live wells and bilges filled with infected water into another body of water, and taking a boat or other recreational equipment from an infected body of water into a new body of water without rinsing it and drying it thoroughly (Michigan Department of Natural Resources, 2014c). Although the action of draining bilges and live wells is required by law, there has not been a citation issued in Michigan for violation of this law (Lee, O'Keefe, Oh, & Han, 2015).

There are stakeholder groups that play a role in these pathways for VHS virus transmission. The largely targeted groups in Michigan are anglers and boaters. A study

of Great Lakes anglers found that at least ten percent of anglers in Michigan never follow five best practices for reducing the spread of fish disease and aquatic invasive species when moving from one body of water to another (Connelly, Lauber, & Stedman, 2014). Another study involving registered boaters in Wisconsin and Michigan revealed that boaters have not adopted "consistent and effective boat cleaning habits," and more than two-thirds of boaters surveyed via mail or in-person for the study (n=944 and n=459) do not always clean their boats (Rothlisberger, Chadderton, McNulty, & Lodge, 2010). Most currently, there has been a increasing trend in Michigan boaters to, at a minimum, occasionally wash their boats between bodies of water (Lee et al., 2015). Lee et al. (2015) also found that there is confusion among Michigan boaters as to what actions are required by law or recommended best practices. Despite the confusion, they showed an intention to follow the laws (Lee et al., 2015). This study addresses the perception of Michigan boaters relative to fish diseases, using VHSV as a case study.

A less targeted group is the enthusiasts of other recreational water sports, like canoeing and kayaking, where equipment is easily and often transferred among different bodies of water. The VHS virus can remain infective in water for up to two weeks (Wisconsin Department of Natural Resources, 2016). VHS and other fish diseases can be transferred on their equipment and those paddling should take measures to clean their kayaks, canoes, etc. While baitfish industry and hatcheries also play a role by ensuring that the bait they produce for sale is disease-free, aquatic recreational users also play a critical role. Awareness of the variety of roles humans play in potentially transmitting fish diseases within these stakeholder groups is imperative, so fish populations can stay healthy and Michigan citizens continue to benefit from the economic contributions of

fishing, boating, and paddling activities.

Apart from anglers and other water sport enthusiasts, another stakeholder group that may be concerned about the spread of fish disease and its impact on fisheries are the consumers of Great Lakes fish. Although VHS, like most fish diseases, poses little risk of infecting humans through consumption, it is still important for those eating fish to be aware that fish disease has the potential to impact whether a fish even makes it to their dinner table. Michigan has a culture of fishing and fish consumption that could be negatively impacted by fish disease because of reduced fish populations, including geographic areas such as the Upper Peninsula that has a popularity of Friday night fish fries, and ethnic groups, such as Native American tribes that may fish for and eat larger amounts of fish (Habron, Barbier, & Kinnunen, 2008).

In addition to regulations, management agencies have also recognized the importance of education and outreach to address the spread of fish pathogens and aquatic invasive species (AIS). Initially, outreach focused on raising general awareness of fish diseases like VHS but then over time, evolved into education about how pathogens are spread, how people are involved in that process, and what they can do to help reduce the spread of pathogens and AIS (Heck, Lauber, & Stedman, 2013).

For all of the stakeholder groups to follow their respective best practices to reduce the likelihood of spreading of fish diseases, trust in the agencies that provide educational outreach is important. Trust in institutions is a factor that is important in risk perception and evaluation (Covello, 1992). Renn & Levine (1991) defined trust within a communication context, stating "Trust in communication refers to the generalized expectancy that a message received is true and reliable and that the communicator

demonstrates competence and honesty by conveying accurate, objective, and complete information" (Renn & Levine, 1991). As citizens, we process information and determine our trust in it every day, from the local weather forecast, to the news– even outreach materials about fish diseases. Not only are we determining our trust in the information, but the agency that is providing it to us.

As stated above, it is known that trust in institutions, or agency trust, plays a large role in people's risk perceptions and how people respond to communication about risks (Poortinga & Pidgeon, 2003). As a state agency, trust in the MDNR is important, as Lundgren & McMakin (2013) state, "…information alone, no matter how carefully packaged and presented, will not communicate risk effectively if trust and credibility are not established first" (Lundgren & McMakin, 2013). Also, trust in certain aspects of the agency may vary. Overall, "…surveys indicate high trust of government agencies to solve environmental problems, but there is evidence of distrust with regard to the management of specific issues" (Cvetkovich & Winter, 2003). For determining trust for specific issues like fish disease management, one would investigate stakeholders' trust in the MDNR Fisheries Division.

The MDNR has a Fisheries Division that manages fishing regulations, licenses, and fish stocking throughout the state. The Fisheries Division also has a fisheries education and outreach section that develops fisheries related programs. Other divisions within the MDNR that play important roles in communicating about fish diseases and AIS are Parks and Recreation and Marketing and Outreach. The MDNR Fisheries Division is further divided into management units, in which the delineations of each unit can be observed below (Figure 1.4).

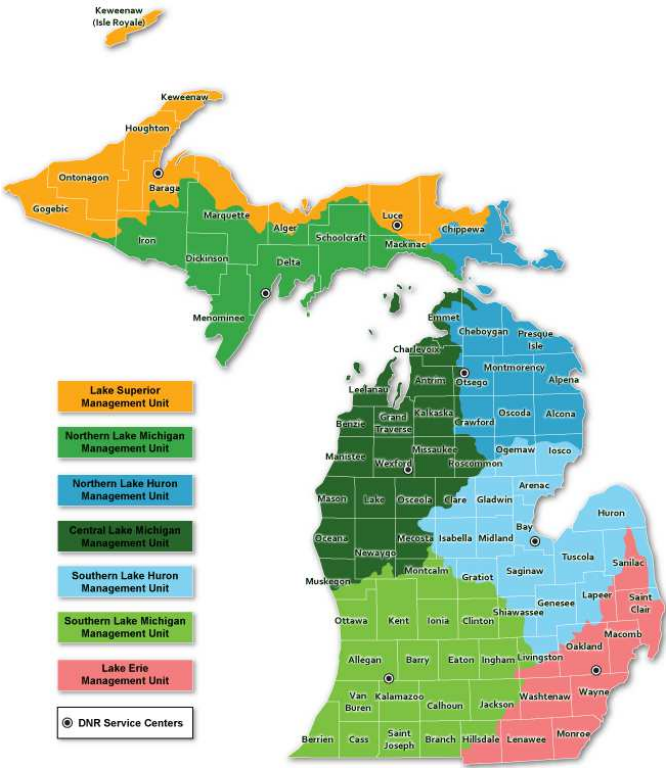


Figure 1.4. Map of MDNR Fisheries management units (from http://www.michigan.gov/documents/dnr/fmd_MU_internal_378278_7.html).

How residents trust the agency can have a great affect on their perceived risks of fish disease and their behaviors to conduct best practices to reduce the transmission of fish diseases between bodies of water. This study investigated the relationship between agency trust and perceived risks, as well as variations that may occur in trust in a region where the three VHS management area types of Michigan converge.

In areas of wildlife human dimensions research, the two peninsulas of Michigan have had distinct differences in public opinion related to natural resources and their management. In a study conducted by Lute et al. (2012), the residents of the U.P. had different perceptions about wolves than the rest of the state (Lute, Gore, Nelson, & Vucetich, 2012). In another study involving white-tailed deer, Riley and Lischka (2009) stated, “How stakeholders perceive deer and deer management in Upper Peninsula (UP),

Northern Lower (NLP), and Southern Lower (SLP), however, is as different as the unique landscapes of these regions" (S. J. Riley & Lischka, 2009).

This study looks at potential differences in the collected data spatially, comparing the three VHS management area types in an area where they converge– the Eastern Upper Peninsula. To my knowledge, this type of geographic comparison has yet to be applied in the area of fisheries. Knowing more about stakeholders' risk perceptions and levels of trust within each management area can help to identify the possible need of tailored outreach to certain VHS management areas of the state.

Collectively, Michigan boating/watersport enthusiasts and anglers share at least one thing in common: the desire to utilize the Great Lakes water and fishery resources. The investigation into what risk perceptions people have and their level of trust in fishery management agencies could be helpful in developing future outreach to protect and conserve the fishery and water resources that they depend upon.

Previous studies have investigated reducing the spread of AIS and fish pathogens. Conducted by Cornell University's Human Dimensions Research Unit (HDRU), one study surveyed anglers, and another fisheries managers. Both studies included samples from many Great Lakes states, not just Michigan. Findings suggest that anglers in Michigan were "more likely to be aware of VHS and think VHS was a major threat to the health of fish populations in the Great Lakes region than anglers in other states" (Connelly et al., 2014). As the sample size from Michigan in the study included just anglers, this thesis research sought to have respondents of other potential target audiences, for example, recreational paddlers and boaters.

Theory

The model that will be used for this study is a model revised from Clarke (2009) and Triezenberg et al. (2014), the Zoonotic Disease Risk Information Seeking and Processing (ZDRISP) model. This research contributes to the expansion of the ZDRISP model to a fishery context by using a case of a fish pathogen as a special type of AIS, toward developing a theoretical framework that can be used across natural resource contexts. For the purpose of this study, the model has been modified to a fisheries context by using VHS as a case study for testing the framework. This disease was chosen because it has been in Michigan waters for about a decade and has had coverage in press as well as the continuing presence of its rules and regulations in fishing guides since its discovery in the Great Lakes. It is one of the more prominent diseases that have been in the Great Lakes region; therefore, it is thought that more people should know or have heard about it and is used as a case study in this research of fish diseases, which may be invisible to most stakeholders.

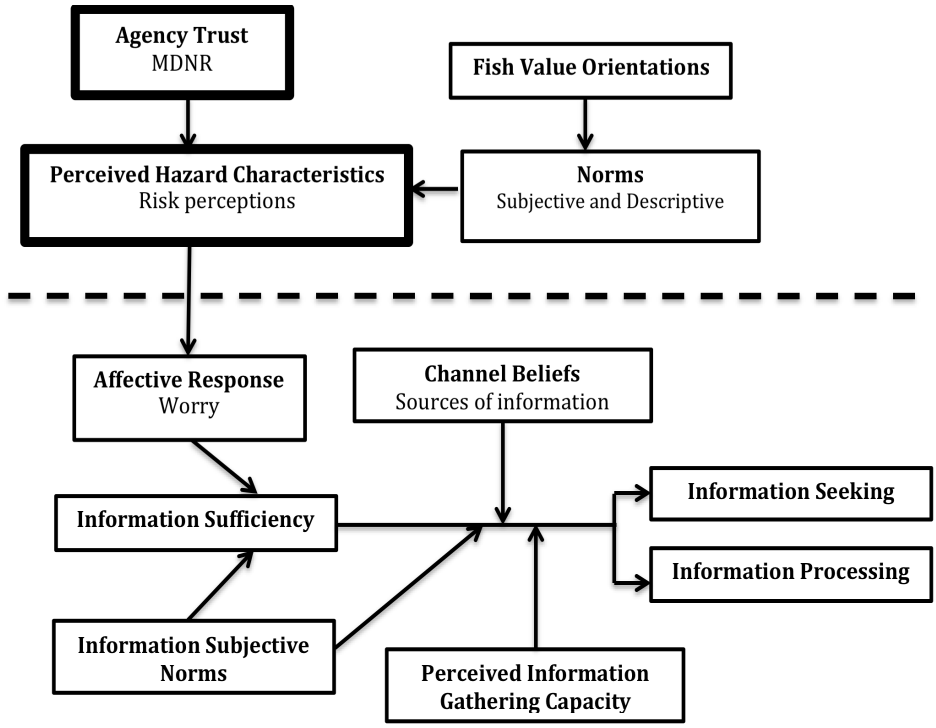


Figure 1.5. Simplified version of ZDRISP model. Bolded boxes above the dotted line are the attributes this study investigated (Griffin et al. 1999, Clarke 2009, Triezenberg et al. 2014).

This thesis research investigated two attributes of the model: agency trust and perceived hazard characteristics. Agency trust is an attribute that has been elicited for this study, as a factor affecting perceived hazard characteristics, to contribute to enhancing the ZDRISP model and testing in a fisheries context. Both attributes are found in the bolded boxes above the dotted line in Figure 1.4. Perceived hazard characteristics are perceived risks, which are defined as people's "intuitive risk judgments" (Slovic, 1987). Perceived hazard characteristics are divided into two categories: perceived disease risks and perceived disease management risks. Both categories are looking at perceived risks regarding health, economic livelihood, environmental concern, fishing, and the culture of fisheries, but perceived disease risks asks people about their perceived risk in regard to VHS itself, and perceived disease management risks asks about the perceived risk of VHS management.

The attributes of the perceived hazard characteristics are defined as follows:

1. Risks to your health- Perceptions that the individual's personal health is at risk from VHS or VHS management.
2. Risks to the natural environment- Perceptions that fish populations, other aquatic animals, the balance of food webs, etc. are at risk from VHS or VHS management.
3. Risks to your economic livelihood- Perceptions that the individual's personal way of supporting yourself financially is at risk from VHS or VHS management.
4. Risks to fishing in Michigan- Perceptions that successful catch rates and angler recruitment are at risk from VHS or VHS management.
5. Risks to the culture of fishing in Michigan- Perceptions that the reputations of fishing communities and how people currently fish are at risk from VHS or VHS management.

Perceived risks of lay people are important to measure because they usually differ from those of experts (Slovic, Fischhoff, & Lichtenstein, 1979). Lay people have more subjective perceptions influenced by imaginability and memorability of a hazard, as well as other characteristics such as dread, likelihood of a mishap being fatal, and catastrophic potential of a risk, while experts' perceptions tend to lie closer to risk statistics (Slovic et al., 1979). Risk perceptions are complicated; it may not matter what statistics say, people formulate their own perceptions using their own experiences and biases.

In this study, agency trust has been introduced as an attribute that influences

perceived hazard characteristics. Previous studies have found that people who trust the managing agency usually perceive less risk than those who do not trust the agency (Vaske, Timmons, Beaman, & Petchenik, 2004). Although titled "agency trust," the trust measured in this study is also known as social trust and a five-item social trust scale was adapted from the scale used by Vaske et al. (2004) from a terrestrial to aquatic disease context. Social trust is the willingness of a person to trust those who are charged with making decisions and taking actions related to the management of the environment, medicine, technology, and other public health and safety issues (Siegrist, Cvetkovich, & Roth, 2000; Vaske et al., 2004).

Siegrist et al. (2000) posited that it is important to know who, in this case, what agency to trust, when citizens may not have the time, knowledge, interest, or abilities to personally make decisions or take actions in the issue (Siegrist et al., 2000). Also, social trust goes beyond interpersonal trust, as the agency personnel that have the responsibility for managing the risk may not be personally known by members of the public (Siegrist et al., 2000). In addition, social trust can be most influential when individual knowledge about the risk is lacking (Siegrist & Cvetkovich, 2000). The agency used in the model for this study is the MDNR Fisheries Division.

Vaske et al. (2004) tested the role of hunters' social trust in the Wisconsin DNR in regard to Chronic Wasting Disease, a type of transmissible spongiform encephalopathy similar to mad cow disease and is another zoonotic disease that causes fatalities in species affected, including white-tailed deer (*Odocoileus virginianus*), mule deer (*Odocoileus hemionus*) and Rocky Mountain elk (*Cervus elaphus nelson*) (Vaske et al., 2004). Although it was not statistically significant in their study, social trust in the agency

(MDNR Fisheries Division) may be significant in a fisheries context and therefore was included in the model for this thesis research.

These two attributes, perceived hazard characteristics and trust were chosen for testing from the adapted ZDRISP model because of the development of risk communication materials in collaboration with the MDNR Fisheries Division in Part B (See Chapter 4) of the thesis research. By investigating hazard characteristics and trust, it helped to inform what perceived risks to target in the risk communication materials as well as gave insight to the MDNR if they are trusted to communicate about fish disease risks.

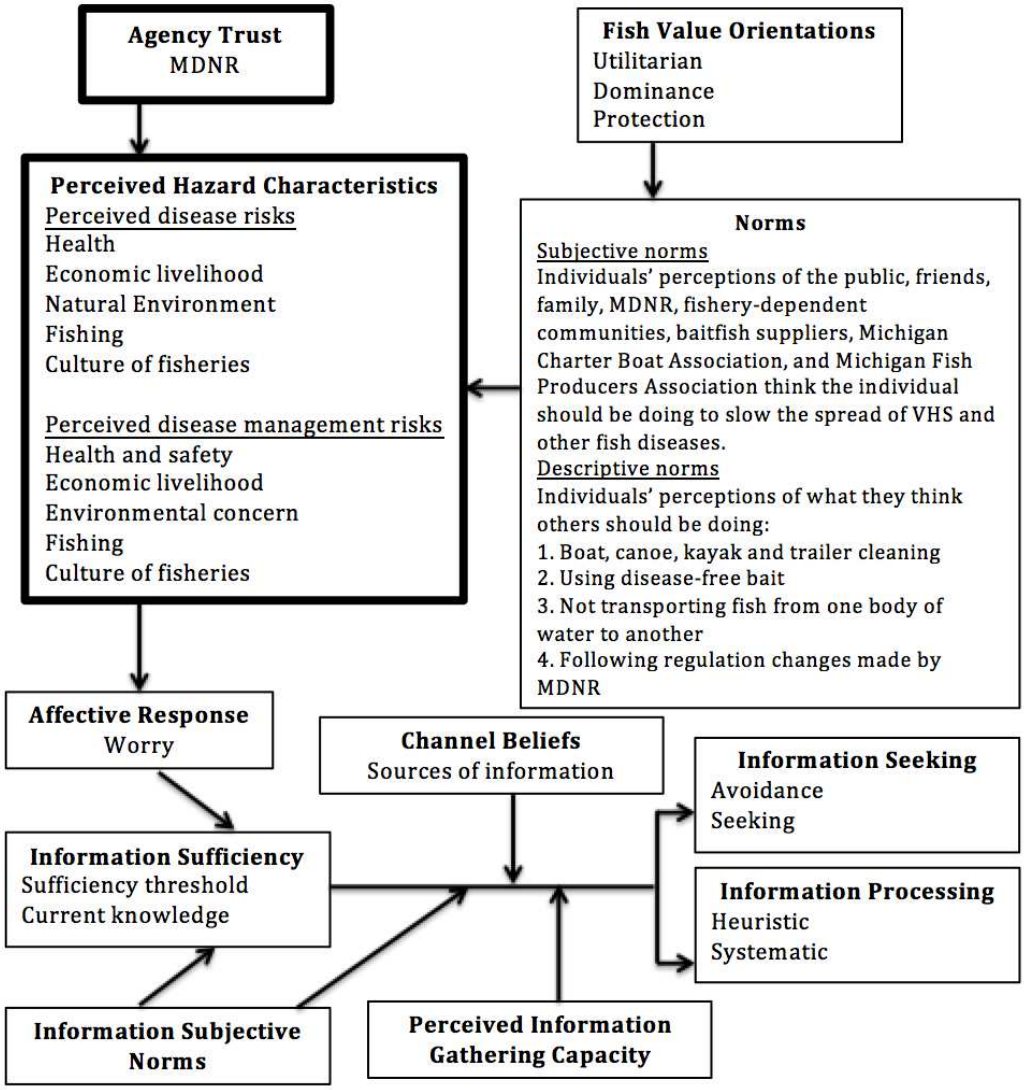


Figure 1.6. Revised ZDRISP model from Clarke (2009) and Triezenberg et al. (2014) to a fisheries context. Agency Trust has been introduced as a factor affecting perceived hazard characteristics.

As seen above in Figure 1.6, Triezenberg et al. (2014) expanded the ZDRISP model to include social norms. These norms also influence perceived hazard characteristics. Norms are comprised of two categories, subjective and descriptive. Subjective norms are perceptions about an individual's perceptions of what other people think they (the individual) should be doing, while descriptive norms are an individual's perceptions about what other people are doing (Triezenberg et al., 2014a). In this

research, subjective norms include the individual's perceptions of what different groups, including the public, friends, family, MDNR, fishery-dependent communities, baitfish suppliers, Michigan Charter Boat Association, and Michigan Fish Producers Association, think an individual should be doing to stop the spread of VHS. The descriptive norms, what an individual perceives other people are doing to stop the spread of VHS include boat, canoe, kayak, and trailer cleaning between bodies of water, using disease-free bait for fishing, not transporting fish from one body to another, and the following the regulation changes made by MDNR to stop the spread of VHS.

Social norms are influenced by fish value orientations. For the context of this thesis research, wildlife value orientations have been changed to fish value orientations. These orientations are utilitarian, dominance, and protection and were developed and used by Bruskotter and Fulton (2008) in a fisheries context. Some studies suggest that value orientations lie on a scale between anchors of anthropocentric and biocentric values, but Bruskotter and Fulton (2008) results "suggest that value orientations may not be able to be adequately captured using a single, anthropocentric–biocentric measure" (Bruskotter & Fulton, 2008). Because of these findings, this revised model will employ separate fish value orientations.

Other attributes of the model are channel beliefs and perceived information gathering capacity. Channel beliefs are the sources of information people are using to educate themselves about VHS. Perceived information gathering capacity is a person's perception of their ability to find information on the issue (Clarke, 2009). Although the rest of these described attributes are not used in this study, they are explained for overall understanding of the ZDRISP model.

Using the information found by testing the agency trust and perceived hazard characteristics attributes of the modified ZDRISP model, a pilot outreach communications campaign was created in collaboration with MDNR Fisheries Division communication staff to address targeted stakeholder risk perceptions and concerns about aquatic-based zoonotic diseases. Gore and Knuth (2006) stated the importance of investigating perceptions at the individual level, as "individual change is a precursor to community-level effects" and that knowing information about individuals can help to tailor outreach to specific stakeholder groups (Gore & Knuth, 2006).

The use of outreach communications campaigns can be promising in disease management. A study by Triezenberg et al. (2014) found that using a persuasive communication campaign tailored to specific audiences was able to cause changes in hunters' risk perceptions of bovine tuberculosis at a significant level immediate post-exposure to the outreach campaign (Triezenberg, Gore, Riley, & Lapinski, 2014b). In agreement with Gore and Knuth (2006), this study also stated the importance of tailoring communications to specific target audiences (Triezenberg et al., 2014b).

A study of Michigan boaters exposed once to AIS outreach materials have no significant intentions to follow best practices compared to non-exposure, even those required by law (Lee et al., 2015). Multiple exposures to messages are needed, as it may influence social norms and change behavior (Lee et al., 2015). Also, Lee et al. (2015) reported that more comprehensive AIS messages can help to educate boaters on what actions are required by law (Lee et al., 2015). These findings could be translated into developing communication materials about VHS and other aquatic diseases, as well as informing needed policies as boaters display a high intention to follow laws regarding

AIS (Lee et al., 2015).

Gain and loss framing, a risk communication approach, was used in Part B (See Chapter 4) of this thesis research. In risk communication, risks can be framed as either gains or losses, meaning that they can be described positively as a gain, such as, "There is an 80% chance of survival." Alternatively, risks can be described negatively as a loss, such as, "There is a 20% chance of death." It is important that gain frames can both describe "the good things that will happen and the bad things that will not happen", as well as loss frames describe "the bad things that will happen as well as the good things that will not happen" (Rothman, Bartels, Wlaschin, & Salovey, 2006, p. S203).

Examples of MDNR Fisheries Division messaging about VHS best practices and fish disease are shown below (Figures 1.7 and 1.8). These examples can be viewed as a gain frame, because it communicates that doing the action of throwing unused bait in the trash will lead to a positive outcome, which is helping keep Michigan's waters stay world class. An example of possible loss framing of this message would be that, "We could lose the quality of Michigan's waters if you don't throw away unused bait in the trash."

Figure 1.7. An example of MDNR VHS messaging using a gain frame.

Figure 1.8. An example of an MDNR broader message for "fish diseases."

Tversky and Kahneman (1981) showed that the framing of a decision could change individual preferences. Since then, framing in communications research has come a long way, although it does not seem clear which frame— gain or loss— is most effective across situations. For low-risk preventative behaviors in the context of human health, a review of literature has suggested that gain frames will be slightly more effective (O'Keefe & Jensen, 2007). Yet, loss frames in conjunction with losses to the current generation were more effective in communicating about environmental behaviors (Davis, 1995). As framing seems to be more context specific, this research sought to determine which frame is most effective for communicating risks of fish disease. Knowing this information will be very important for how risks of VHS and other aquatic diseases will be communicated by the MDNR and other natural resource agencies in the future.

CHAPTER 2

METHODS

Overview

This thesis research was comprised of two parts– A, testing of attributes of the ZDRISP model with interviews; and B, testing of gain and loss framed communication messages through community engaged scholarship. Research methods for Parts A and B were approved by the Michigan State University (MSU) Institutional Review Board (IRB) on June 12th, 2015 and February 18th, 2016, respectively, under IRB# x15-651e (See Appendix E). Part A was comprised of anonymous, semi-structured interviews using convenience sampling to collect background information of stakeholders and identify their risk perceptions and concerns of VHS as well as their trust in the MDNR Fisheries Division. Part B included the development pilot outreach messages through the MSU Graduate Certificate in Community Engagement in partnership with the MDNR Fisheries Division to address the top stakeholder risk perception about VHS identified from testing the ZDRISP model in Part A. Part B of the thesis research used the pilot outreach messages to test the effectiveness of gain and loss framing within the context of fish disease in order to gain insight of how to most effectively communicate its risk. Part B methods included structured interviews using convenience sampling at events focused on aquatic-based recreation to evaluate if the framed communication was effective in influencing individuals' behavioral intentions to follow laws, seek more information, their beliefs that fish disease poses a risk, and their trust in MDNR Fisheries Division communications.

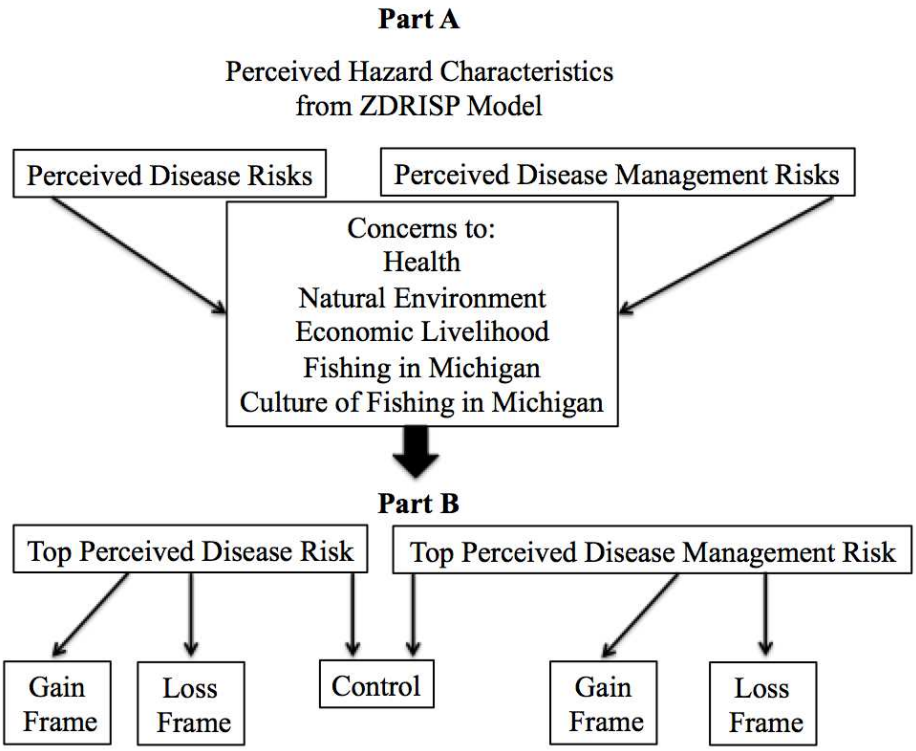


Figure 2.1. Use of ZDRISP variables found in Part A, for incorporation in gain and loss framing for outreach materials in Part B.

Part A

The semi-structured interviews of Part A took place in the first two weeks of both July and August 2015. Interviews were held Thursday through Sunday, with Wednesday used as an alternate day for poor weather conditions. Morning and evening hours were used in interviewing; as 10 a.m. to 2 p.m. and 4 p.m. to 8 p.m., were identified as the likely hours people would be coming off the water (Ferguson, 2015). Two different access points were visited per interview day and were scheduled to have equal morning and evening hours throughout the four weeks of interviewing in order to gather a wider variation of participants, as one site may be more or less busy than another on any given day or time of day (See interview schedule in Appendix A). The paired access points were Brimley and Paradise, Sault Ste. Marie and Raber, St. Ignace and Hessel, and

Naubinway and Curtis.

A convenience sample of aquatic-based recreation users was interviewed at each access location. I either approached those who were participating or showed evidence of participation in aquatic-based recreational activities– such as an observation of paddling equipment (e.g. kayaks, canoes) on or a boat trailer behind their vehicle– or they revealed themselves to participate in aquatic-based recreational activities and invited them to participate in this study anonymously. Potential participants were offered an incentive of a chance to win one of five $50 Walmart gift cards to complete the interview. If participants chose to enter the drawing, they were given a separate card to provide their contact information. This information was kept in a separate database from the participants' interview responses. The five gift card recipients were randomly drawn using their contact information cards and the five gift cards were mailed to the recipients in late August 2015. The testing of communication materials in Part B took place at selected events in the spring of 2016.

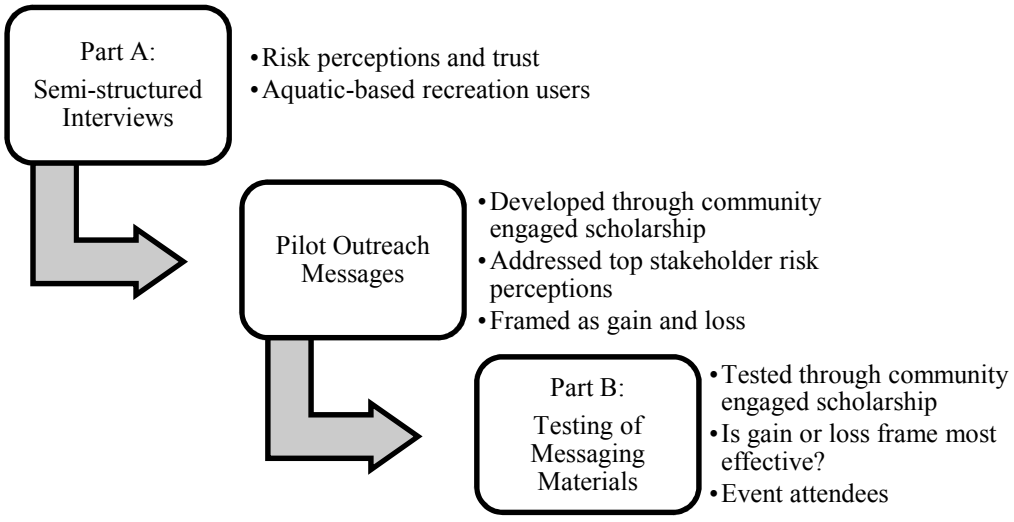


Figure 2.2. Parts of the thesis research.

For Part A, semi-structured interviewing was the method of data collection from

aquatic-based recreation users at aquatic-based recreation access locations in Chippewa and Mackinac counties in the Upper Peninsula of Michigan. These locations were chosen for their positions within all three types of VHS management areas. Saginaw Bay is also an area in Michigan where the three VHS management area types converge, but the Upper Peninsula was chosen as there were access points on three Great Lakes, compared to one in the Saginaw Bay area. Brimley (Bay Mills Ramp), Paradise (Tahquamenon River Mouth Access Point), and Curtis (City Boat Launch) are located in the free area, Sault Ste. Marie (William R. Gregory Boat Launch), Naubinway (Naubinway Marina), and Raber (City Boat Launch) are located in the surveillance area, and Hessel (Hessel Marina) and St. Ignace (City Boat Launch) are located in the positive area.

The interviews followed an interview guide (See Appendix B); interview questions included their participation in five different aquatic-based recreational activities, if they had heard of VHS before, their concern for fish disease in the Great Lakes and Michigan's inland lakes, and demographic questions such as age, gender, education level, 2014 household income and their city and state of residence (Triezenberg et al., 2014 and Vaske et al., 2004 for risk perceptions and social trust in the MDNR Fisheries Division, respectively).

If a person agreed to participate, I read an introduction to the interview, which provided background information about myself and my study and informed participants that they were consenting to participate in a research study and they could opt out at any time. I entered participant responses and took notes of participants' responses on a printed sheet throughout the interviews. The number of potential participants who declined was not recorded, so an overall response rate was not calculated. If the

participant consented, the interviews were also digitally recorded. At the end of the interview, participants were provided with a VHS factsheet as well as contact information and IRB approval information if they had any future questions or concerns. The MDNR Fisheries Division's Statewide Research Manager reviewed the factsheet prior to distribution.

Interview responses were anonymous as they were recorded with only an identifying code of letters and numbers used to keep all responses linked to one participant. After the interview was complete and the recording was stopped, I asked if they would like to enter the incentive drawing. Contact information collected for the drawing was kept separate from completed interview guides and recording, and was kept confidential to only the MSU IRB approved investigators. The interview quantitative data from the interview guides were entered into an Excel spreadsheet and uploaded to IBM SPSS Software for Macintosh, Version 22.0 for analysis (IBM Corp., Released 2012). Interview recording files were downloaded to NVivo for Mac (QSR International Pty Ltd., 2014).

Interview quantitative data for the sample (N=80) were analyzed using IBM SPSS Statistics Version 22 (IBM Corp., Released 2012). Descriptive statistics, crosstabs, and Fisher's Exact Tests were used to report the data. Fisher's Exact Tests were used instead of Chi-Square Tests because many cells in each crosstab had a value less than five. Qualitative data from the interviews were coded using NVivo for Mac Version 11.0.0 (QSR International Pty Ltd., 2014). Using a process similar to the scan, order, review and compare method (Lute & Gore, 2014), each interview was listened to for themes and responses to open-ended questions were coded by themes and marked at the

corresponding point in the audio file. Listening to the audio files was a chosen method to fulfill the research objective, as only overall themes were needed, not complete transcripts. Descriptive statistics– mostly frequencies– and representative quotes were used to report qualitative data.

Part B

From the results of the interviews, a pilot outreach communications campaign was developed in collaboration with MDNR Fisheries Division communication staff through scholarly engagement (Doberneck, Glass, & Schweitzer, 2010; Glass & Fitzgerald, 2010). This activity fulfilled the requirements for the MSU Graduate Certification in Community Engagement program. In partnership with a communication specialist for the MDNR Fisheries Division, a research topic of gain and loss framing was selected and the interview guide (See Appendix D) was developed with input from extension staff gathered through a project mentor and fellowship experience affiliated with Michigan Sea Grant Extension.

Part B of this thesis research tested the efficacy of the outreach campaign and whether a gain or loss frame is more effective. Using a 2x2 factorial design including a control, five different messages were tested– a gain and a loss message focused on fish disease risk, a gain and a loss message focused on fish disease management risk, and a control message that was not gain or loss framed (Crano & Brewer, 2002, pp. 65-67; Davis, 1995; O'Keefe & Jensen, 2007; Rothman et al., 2006; Tversky & Kahneman, 1981). All of the four framed messages focused on risk to the natural environment, which was identified as the most frequently identified risks from the interviews in Part A of the research.

Part B research used a convenience sample frame of structured interviews of respondents aged 18 years or older at various events with scheduled DNR booths. Interview responses were anonymous as they were recorded with only an identifying code of letters and numbers used to keep all responses linked to one participant. After the interview was complete, I asked if they would like to enter the incentive drawing. Contact information collected for the drawing was kept separate from completed interview guides and was kept confidential to only the MSU IRB approved investigators.

Data was collected at the following events in February and March 2016: the Grand Rapids Boat Show in Grand Rapids, MI, Outdoorama in Novi, MI, West Michigan Women's Expo in Grand Rapids, MI, and the Ultimate Sport Show in Grand Rapids, MI. Each event had a MDNR outreach booth scheduled, and I coordinated with a department specialist in the Marketing and Outreach Division to attend the events and get permission to collect data at the MDNR booths. Data were collected at these events on Saturdays and interviews were scheduled in two three-hour shifts— from 10am-1pm and 2pm-5pm. This research used anonymous structured interviews as the basis for data collection.

I approached potential study participants in person, inviting them to voluntarily participate in the study and informed them of an incentive opportunity to win one of five $20 Meijer gift cards for completing an interview. If a person agreed to participate, I read an introduction to the interview, which provided background information about myself and my study and informed participants that they were consenting to participate in a research study and they could opt out at any time. I completed a data sheet for each respondent, manually recording his or her responses. The number of potential participants who declined was not recorded, so an overall response rate was not calculated.

The research collected information of aquatic-based recreation activities people participated in via yes/no questions (same as Part A interview) and a Likert scale of awareness of laws and recommendations to slow the spread of fish diseases (per request of the partner in the engaged scholarship project) and current behaviors regarding slowing the transmission of fish diseases (from Lee et al. 2015). Only one printed message (See Appendix C) was shown to each participant and rotated one through five throughout the interview day. After being shown the selected outreach message, post-message questions included Likert scales of behavioral intentions to seek information about fish disease, belief of risk from fish diseases, and trust in the DNR message– which corresponded to the information seeking, perceived hazard characteristics, and agency trust ZDRISP model variables respectively. The interview asked belief, behavior, and trust questions after the message, and not before and after, to avoid social desirability bias– the need for people to show individual improvement (Lee et al., 2015).

To conclude, demographic questions were asked, including if the person was male or female, the year they were born, their level of education, 2015 household income, and city and state of residence. The quantitative data from Part B of the thesis research were analyzed using IBM SPSS Statistics Version 22 (IBM Corp., Released 2012). Kruskal-Wallis H tests were used, as the sample size for each message shown was small (N=82; n=16 or 17 per message), and the test allows for more than two independent groups to be tested on ordinal-scale dependent variables. All dependent variables were analyzed using a Kruskal-Wallis H test for the five messages shown (gain/disease, loss/disease, gain/disease management, loss/disease management, and control). Other grouping variables used for this test were education level, 2015 household income level, and the

event attended. Mann-Whitney U tests were used as well for grouping variables that had only two categories– like gender (male/female) and participation in five different aquatic-based recreational activities (yes/no).

For both the Kruskal-Wallis H tests and Mann-Whitney U tests, the dependent, or response, variables tested were: seeking more information to reduce the spread of fish diseases, intention to follow the laws and recommendations to slow the spread of fish diseases, the beliefs that fish diseases pose a risk to fisheries and the natural environment (also known as risk perceptions), the desire to learn more about DNR Fisheries Division's fish disease management, and trust in the DNR communication shown.

CHAPTER 3

RISK PERCEPTIONS OF FISH DISEASE IN MICHIGAN: TESTING THE ZOONOTIC DISEASE RISK INFORMATION SEEKING AND PROCESSING (ZDRISP) MODEL IN AN AQUATIC CONTEXT

Abstract

This research tested attributes of a Zoonotic Disease Risk Information Seeking and Processing (ZDRISP) model adapted to an aquatic context using a fish disease, viral hemorrhagic septicemia (VHS), as a case study (Clarke, 2009; Triezenberg et al., 2014a). Data were collected from participants (N=80) in eight different access points in the Eastern Upper Peninsula of Michigan, where the three types of VHS management areas converge. Trust in the Michigan Department of Natural Resources (MDNR) Fisheries Division was introduced as a variable influencing risk perceptions of the disease and disease management. Differences in trust in the MDNR Fisheries Division between VHS management areas were also tested. The study also included qualitative investigation of participants' risk perceptions of VHS and its management to five different types of risk– to their health, to the natural environment, to their economic livelihood, to fishing, and to the culture of fishing in Michigan. This chapter provides an overview of how the ZDRISP model was adapted to an aquatic context and discusses implications for natural resource agencies and future testing of the ZDRISP model. Results include descriptive responses of what aquatic-based recreational users were concerned about pertaining to risks of VHS and its management and what influences their trust in the MDNR Fisheries Division. Trust was found to be significant in perceived risk to the natural environment at level α=0.10. Insights from this study can provide fishery agencies a foundation for planning communications about VHS and fish diseases in a broader context.

Introduction

One global threat to freshwater and marine fish populations is disease caused by bacteria, fungi, protozoa, or viruses (S. C. Riley, Munkittrick, Evans, & Krueger, 2008). Fish diseases do not only affect the Great Lakes region, they are found worldwide in both the natural and hatchery environments. Some are zoonotic, meaning that they can be transmitted from wildlife or fish to humans. A large proportion of emerging diseases, about 73%, are zoonotic in origin; for example, Ebola, which was transmitted to humans from hunting and butchering infected chimpanzees and gorillas (Machalaba, 2014; Manfredo, 2008). Although they do not have similar risk factors as wildlife zoonoses, fish zoonoses include bacteria and parasites that can infect humans through consumption and handling (Nemetz & Shotts Jr., 1993). Most illnesses can be avoided by following best practices of handling and preparation and overall there is a low occurrence of fish-related cases in the U.S. (Nemetz & Shotts Jr., 1993). Consumption of fish contributed to 73 of 188 seafood-associated outbreaks of infection in humans from the years of 1973 to 2006 in the United States, with salmon (or its fermented parts or eggs) causing 15 outbreaks (Iwamoto, Ayers, Mahon, & Swerdlow, 2010). Yet, other non-zoonotic fish diseases that occur within fish populations are contracted by all kinds of fish and have many types of causes, including bacteria, fungi, parasites, protozoa, and viruses (S. C. Riley et al., 2008). Fishery agencies and Michigan residents have justification to be concerned about this issue. Some fish diseases can create a large impact on the health of fish populations and are the cause of many fish deaths, which in turn impacts the ecosystem the fish exist in. This research sought to investigate the risks stakeholders perceive about fish disease in Michigan.

Zoonotic Disease Risk Information Seeking And Processing Model (ZDRISP)

Risk information seeking and processing (RISP) was first described by Griffin et al. 1999. Since then, the RISP model has been adapted and used in different contexts, from public health to environmental issues (Clarke, 2009; Griffin, Dunwoody, & Neuwirth, 1999; Griffin et al., 2005; Kahlor, Dunwoody, Griffin, & Neuwirth, 2006; ter Huurne, Griffin, & Gutteling, 2009) Previous studies using ZDRISP models as a theoretical foundation for research have been used in a wildlife or terrestrial context (Clarke, 2009; Triezenberg et al., 2014). This study sought to adapt the model to an aquatic context using viral hemorrhagic septicemia (VHS) as a case study. The adapted model is shown below in Figure 3.1.

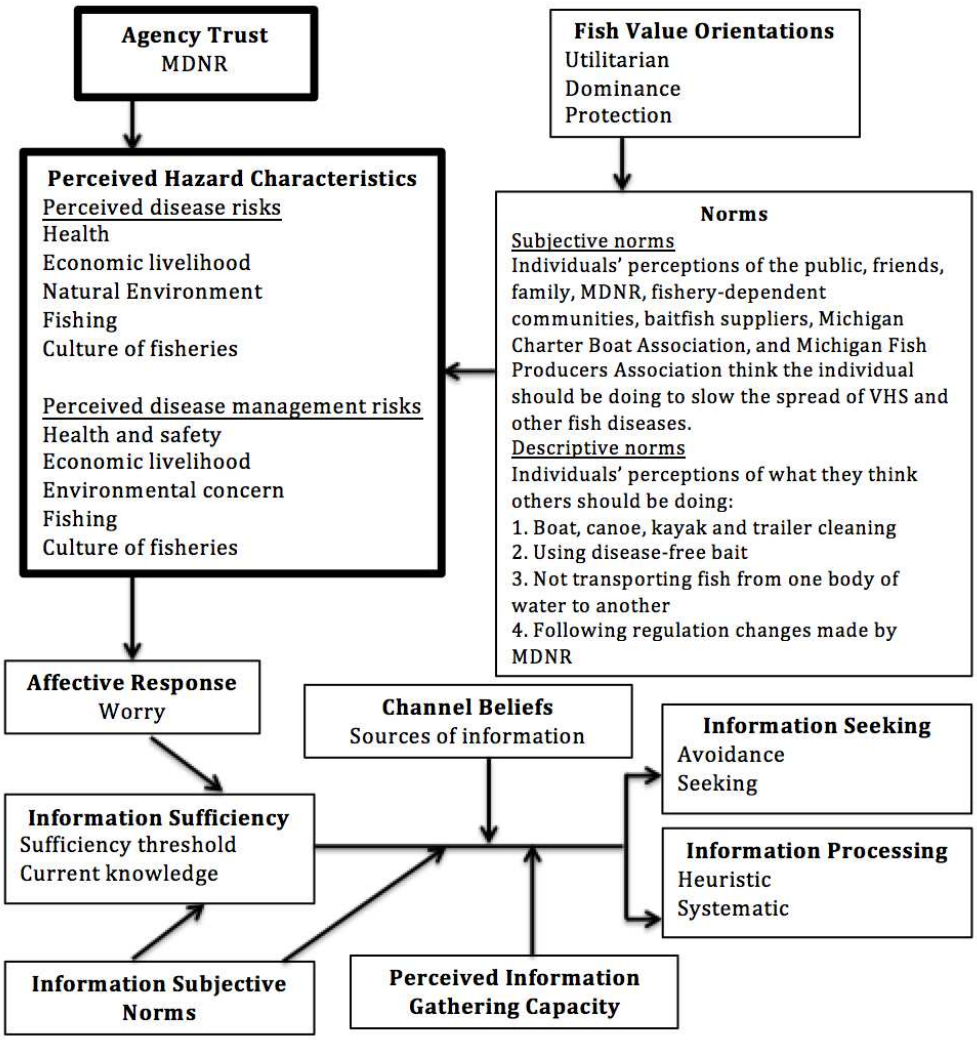


Figure 3.1. ZDRISP model adapted from Clarke (2009) and Triezenberg et al. (2014) to an aquatic disease context with introduced variables of agency trust and perceived hazard characteristics in bolded boxes.

In this model, agency trust has been introduced as a variable that influences perceived hazard characteristics. Previous studies have found that people who trust the managing agency tend to perceive less risk compared to those who do not (Vaske et al., 2004). Although titled "agency trust," the trust measured in this study is also known as social trust, and a five-item social trust scale was adapted from the scale used by Vaske et al. (2004) from a terrestrial to aquatic disease context. Social trust is the willingness of a person to trust those who are charged with making decisions and taking actions related to

the management of the environment, medicine, technology, and other public health and safety issues (Siegrist et al., 2000; Vaske et al., 2004).

Siegrist et al. (2000) posited that it is important to know who, in this case, what agency to trust, when citizens may not have the time, knowledge, interest, or abilities to personally make decisions or take actions in the issue (Siegrist et al., 2000). Also, social trust goes beyond interpersonal trust, as the agency personnel that have the responsibility for managing the risk may not be personally known by members of the public (Siegrist et al., 2000). In addition, social trust can be most influential when individual knowledge about the risk is lacking (Siegrist & Cvetkovich, 2000). Therefore, I introduced agency trust as an attribute that influences perceived hazard characteristics to expand this theoretical model and test in my research. The agency used in the model is the MDNR Fisheries Division, as it is the authoritative body of many fishery regulations, including VHS regulations.

Triezenberg et al. (2014) expanded the ZDRISP model to include social norms. These norms also influence perceived hazard characteristics. Norms are comprised of two categories, subjective and descriptive. Subjective norms are perceptions about an individual's perceptions of what other people think they (the individual) should be doing, while descriptive norms are an individual's perceptions about what other people are doing (Triezenberg et al., 2014a). In this model, subjective norms include the individual's perceptions of what different groups, including the public, friends, family, MDNR, fishery-dependent communities, baitfish suppliers, Michigan Charter Boat Association, and Michigan Fish Producers Association, think an individual should be doing to stop the spread of VHS. The descriptive norms, what an individual perceives other people are

doing to stop the spread of VHS include boat, canoe, kayak, and trailer cleaning between bodies of water, using disease-free bait for fishing, not transporting fish from one body to another, and the following the regulation changes made by MDNR to slow the spread of VHS.

Social norms are influenced by fish value orientations. Fish value orientations are included in the model, rather than wildlife value orientations, as they are more appropriate for the context. These orientations are utilitarian, dominance, and protection and were developed and used by Bruskotter and Fulton (2008) in a fisheries context. Some studies suggest that value orientations lie on a scale between anchors of anthropocentric and biocentric values, but Bruskotter and Fulton (2008) results "suggest that value orientations may not be able to be adequately captured using a single, anthropocentric–biocentric measure" (Bruskotter & Fulton, 2008). Because of these findings, this revised model will employ separate fish value orientations.

Other attributes of the model are channel beliefs and perceived information gathering capacity. Channel beliefs are the sources of information people are using to educate themselves about VHS. Perceived information gathering capacity is a person's perception of their ability to find information on the issue (Clarke, 2009). Although many of these described attributes are not used in this study, they are explained for overall understanding of the ZDRISP model. I chose the variables of perceived hazard characteristics and agency trust to test what I believed to be the foundation of the model– what people perceived as risks of fish disease– and if trust was a variable that helped to understand that foundation.

Tested Attributes: Perceived Hazard Characteristics of VHS and Agency Trust

Viral hemorrhagic septicemia (VHS) is a fish disease caused by a virus and found in over 80 freshwater and marine species in the Northern Hemisphere (Faisal et al., 2012). VHS can be found in many species of fish, all of a wide variety of genus, in the Great Lakes region (Michigan Sea Grant, n.d.). In Michigan, in addition to the Great Lakes, inland waters are also at risk of becoming infected with the virus– two inland lakes, Budd Lake and Baseline Lake, both located in the Lower Peninsula, have been documented as testing positive for VHS in 2007 and 2009 respectively. This disease was chosen as a case study because it has been in Michigan waters for about a decade and has had coverage in press as well as the continuing presence of its rules and regulations in Michigan fishing guides since its discovery in the Great Lakes, although in 2016 VHS rules have been revised in the 2016-2017 fishing guide. Overall, VHS is one of the more publicized diseases that has been in the Great Lakes region and addressed by management agencies since its introduction to Michigan in the mid-2000s; therefore, it is thought that a larger proportion of citizens might have heard about it compared to other fish diseases in Michigan.

I measured Michigan aquatic-based recreational users' risk perceptions of VHS by using perceived hazard characteristics, as defined as risks to:

1. Health- Perceptions that the individual's personal health is at risk from VHS or VHS management.
2. Natural environment- Perceptions that fish populations, other aquatic animals, the balance of food webs, etc. are at risk from VHS or VHS management.

3. Economic livelihood- Perceptions that the individual's personal way of supporting themselves financially is at risk from VHS or VHS management.
4. Fishing in Michigan- Perceptions that successful catch rates and angler recruitment are at risk from VHS or VHS management.
5. Culture of fishing in Michigan- Perceptions that the reputations of fishing communities and how people currently fish are at risk from VHS or VHS management.

Research Questions and Hypotheses

The overall research questions of the study were:

RQ 1: What are the levels of risk perceptions of disease and disease management held by aquatic-based recreation users in Michigan, and what are their levels of trust in the MDNR Fisheries Division?

RQ 2: What is the influence of a trust variable into the ZDRISP model?

Hypothesis 1: Individuals with high levels of trust in the MDNR Fisheries Division will have lower levels of risk perceptions of VHS and its management.

1) Are there spatial variations of trust within the three VHS management areas used prior to 2016?

Hypothesis 2: Levels of trust in the MDNR Fisheries Division between aquatic-based recreational users within different VHS management areas will differ.

Methods

Semi-structured interviewing was the method of data collection from aquatic-based recreation users at aquatic-based recreation access locations in Chippewa and Mackinac counties in the Upper Peninsula of Michigan. These locations were chosen for their positions within all three types of VHS management areas—positive, surveillance, and free— which at the time of data collection were used in baitfish regulations for VHS. Brimley (Bay Mills Ramp), Paradise (Tahquamenon River Mouth Access Point), and Curtis (City Boat Launch) were located in the free area, Sault Ste. Marie (William R. Gregory Boat Launch), Naubinway (Naubinway Marina), and Raber (City Boat Launch) were in the surveillance area, and Hessel (Hessel Marina) and St. Ignace (City Boat Launch) were in the positive area. Data collection locations can be seen below (Figure 3.2).

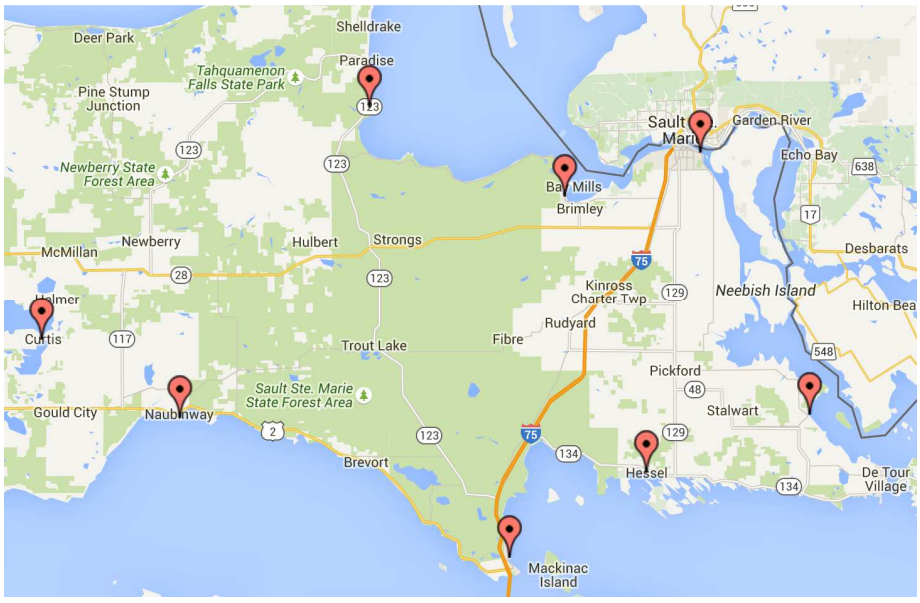


Figure 3.2. Data collection sites in the Eastern Upper Peninsula of Michigan. Map created using BatchGeo (BatchGeo LLC, 2016).

Interviews took place in the first two weeks of both July and August 2015,

Thursdays through Sundays, with Wednesdays being used in the case of inclement weather, following the interview schedule (See Appendix A). Two sites were visited per day, from 10am-2pm and 4pm-8pm, as these were the hours aquatic-based recreational users would likely be coming off the water to the access site. Each access site had a morning and evening and a weekday and weekend sampling in each of the two weeks sampled per month. One interviewer conducted all interviews during the study period.

The interviews followed an interview guide (See Appendix B); interview questions were developed based upon Triezenberg et al. (2014a) and Vaske et al. (2004), for risk perceptions and trust in MDNR Fisheries Division respectively. To gain a more in-depth assessment of risk perceptions of VHS held by aquatic-based recreation users, open-ended questions were used for overall risks of VHS and VHS management, as well as the five types of risks used by Triezenberg et al. (2014).

A closed-ended question was used for both participant top concern of VHS and VHS management to retain reliability with Triezenberg et al. (2014). For each context, VHS and its management, participants were asked about their top concern– to their health, the natural environment, their economic livelihood, fishing, or the culture of fishing (Triezenberg et al., 2014a). To measure agency trust, a five-item index was adapted from Vaske et al., (2004), using a Likert scale of "strongly disagree to strongly agree" including a "don't know" option for each of the following: The Michigan Department of Natural Resources…

1. Provided enough information to make decisions about taking action to slow the spread of VHS and other fish diseases.
2. Can be trusted to provide the best available information about VHS.

3. Information about VHS is believable.
4. Can be trusted to make good management decisions regarding VHS.
5. Provided lots of opportunities to listen to individuals' concerns about VHS.

At the access sites, I either approached people who showed evidence of engaging in an aquatic-based recreational activity or the user identified themselves as a participant of aquatic-based recreational activities, and I invited them to participate. I read an introduction that introduced myself, the research, funding sources, reasons for the research, an incentive of entering to win one of five $50 Walmart gift cards, and finally, questions confirming the participant was over the age of 18 and the oral consent to proceed with the interview.

I recorded responses and took notes of participants' responses on a printed sheet throughout the interviews. The interviews were also digitally recorded upon receiving participant consent. Response rates were not recorded. At the end of the interview, participants were provided with a VHS factsheet as well as contact information and IRB approval information if they had any future questions or concerns. The MDNR Fisheries Division's Statewide Research Manager reviewed the factsheet prior to distribution.

Interview responses were anonymous as they were recorded with only an identifying code of letters and numbers used to keep all responses linked to one participant. After the interview was complete and the recording was stopped, I asked if they would like to enter the incentive drawing. Contact information collected for the drawing was kept separate from completed interview guides and recording, and was kept confidential to only the MSU IRB approved investigators. The interview quantitative data from the interview guides were entered into an Excel spreadsheet and uploaded for

analysis to IBM SPSS Statistics for Macintosh, Version 22.0 (IBM Corp., Released 2012). Interview recording files were downloaded to NVivo for Mac (QSR International Pty Ltd., 2014). Methods for this research were examined and approved by the Michigan State University Institutional Review Board (#x15-651e) on June 12, 2015.

For descriptive explanation, means and standard deviations for each trust item were calculated using a 1 to 5 "Strongly Disagree" to "Strongly Agree" scale and excluded "Don't Know" responses. These means and standard deviations represent the entire sample. Individual mean trust was also calculated to test the research hypotheses below. For the trust variable, the trust items were also analyzed as a scale to determine internal consistency using factor analysis and reliability results from the factor analysis test.

To test Hypotheses 1 and 2, Fisher's Exact Tests were conducted using dichotomous variables for high and low trust and type of risk for VHS. This test allows for a 2x2 cross-tabulation of categorical variables and low cell counts. High trust was categorized as 3.0 and above ("Neutral" response and higher) from the mean trust variable, and low trust was categorized as below 3.0. The mean trust variable for individual participants was calculated excluding "I don't know" responses, and under the condition that respondents had answered at least 3 of the 5 trust items with a 1 to 5 Likert scale response. For each type of risk, the variable was dichotomized into "yes" if the participant responded that certain risk was their top concern, and "no" if they did not. For Hypotheses 3 and 4, a one-way ANOVA test was conducted, using the mean score of the trust scale as the dependent variable and grouped by management area. An ANOVA test was used as the histogram of the mean trust variable had skewness of -0.721 (standard

error=0.297) and kurtosis of 1.223 (standard error=0.586), representing a normal distribution.

Results

Eighty interviews were completed in total; two were incomplete due to participant time and inclement weather and were not included in data analysis, and 6.25% (n=5) of the 80 completed interviews declined that their interviews be digitally recorded Those who declined interviews were not interested or did not have time to participate. Interview participants were 75% (n= 60) male and 25% (n=20) female and averaged 53 years of age (SD=15.35). All participants had at least a high school diploma, 26.3% (n=21) had completed some college or technical school, 26.3% (n=21) had an undergraduate degree, and 25% (n=20) had a graduate or professional degree. Nearly twenty-four percent (n=19) reported a 2014 household income of less than $40,000 before taxes. Thirty percent (n=24) earned a household income of $60,000-100,000. About sixteen percent (n=13) earned a household income of $120,000 or more. Ten percent (n=8) preferred not to reveal their 2014 household income. A majority of participants, 82.5% (n=66), resided in Michigan. The distribution of residences within the U.S. and Michigan are shown below (Figures 3.3 and 3.4). Overall, 55% (n=44) of interviews were conducted in Chippewa County, while 45% (n=36) were in Mackinac County. Almost twenty-nine percent (n=23) were held in Positive VHS management areas, 31.3% (n=25) were held in Surveillance VHS management areas, and 40% (n=32) were held in Free VHS management areas.

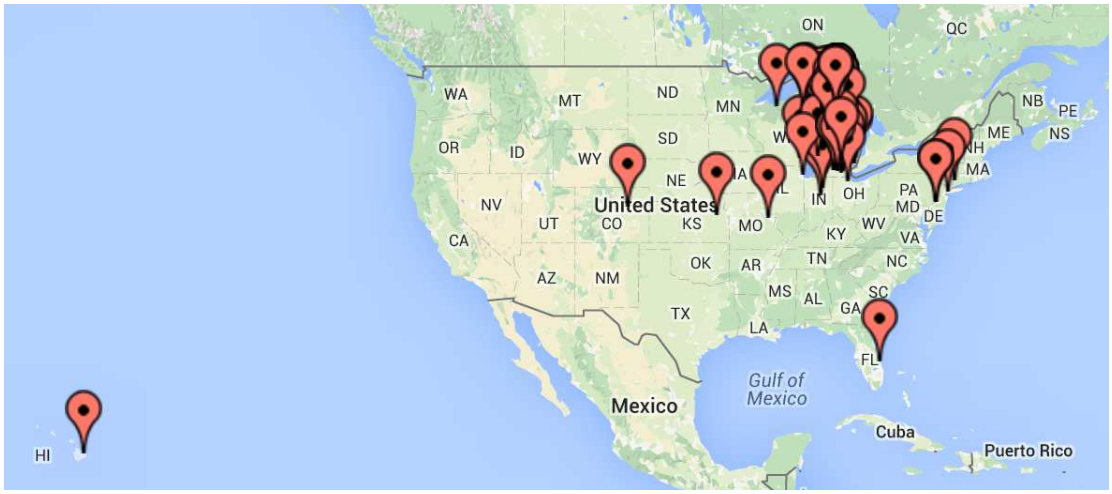


Figure 3.3. Participants' cities of residence. Map created using BatchGeo (BatchGeo LLC, 2016).

Figure 3.4. Participants' cities of residence within Michigan and surrounding states. Map created using BatchGeo (BatchGeo LLC, 2016).

Of interviewees reporting participating in various aquatic-based recreational activities, recreational boating was the activity with the highest participation with 77.5% participating (n=62). Fishing from any type of boat, canoe, or kayak had the second highest participation with 72.5% (n=58), closely followed by fishing from land or shore and recreational paddling, both with 68.8% (n=55). Personal watercraft was the lowest, with only 13.8% (n=11) of the 80 total participants responding they participate in the activity. These data are shown below (Figure 3.5).

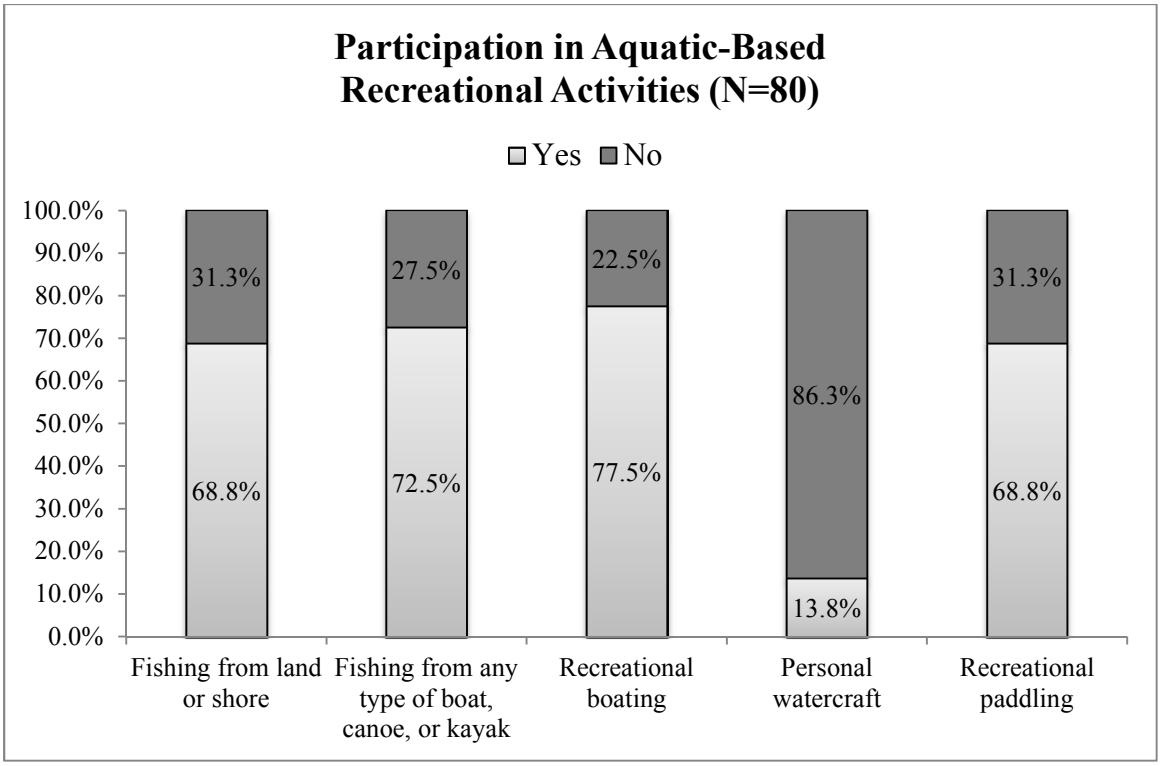


Figure 3.5. Participation in aquatic-based recreational activities (N=80).

The results of these questions are shown below (Figure 3.6). The top concern of VHS is to the natural environment with 40% (n=32), followed by fishing in Michigan with 25% (n=20) and to their health with 21.3% (n=17). The top concern of VHS management is also to the natural environment with 30% (n=24), followed by fishing in Michigan with 26.3% (n=21) and the culture of fishing in Michigan with 22.5% (n=18).

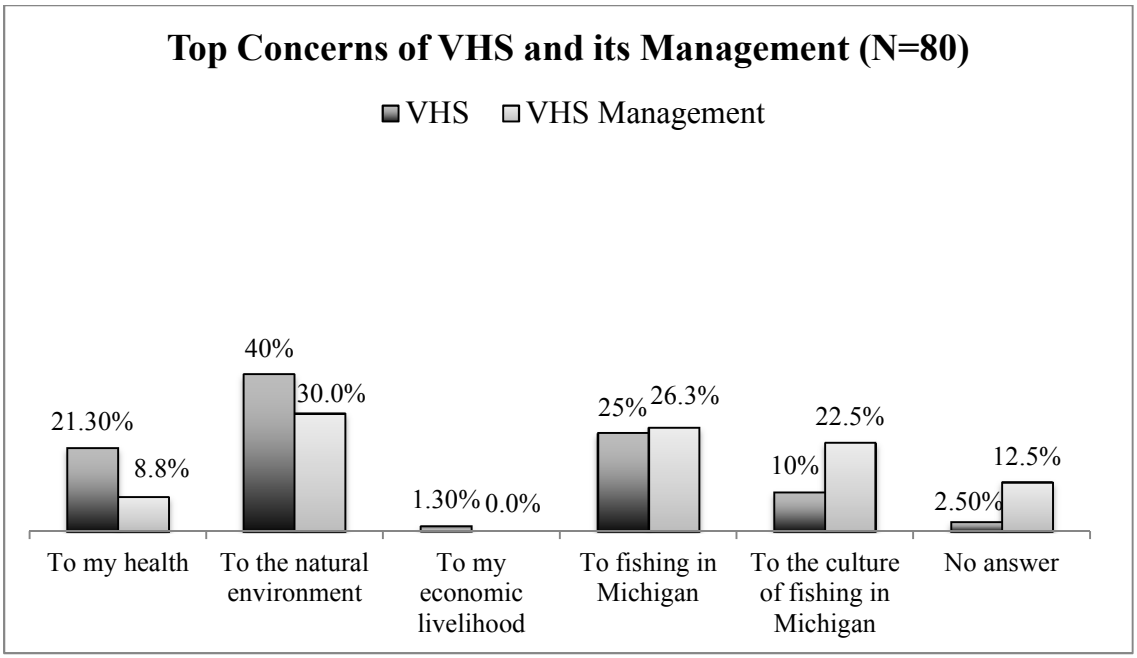


Figure 3.6. Top concerns of VHS and its management (N=80).

Respondents described that they are most concerned about human health risks from VHS and its management as it related to eating fish (n=32). Participants stated, "Probably a risk to our health if we're eating fish, which we do" (B12). "I would assume that if fish are sick, and people eat the fish, people are going to be affected" (P10). Others perceived risks to people in general (n=8) and human health (n=7) overall. Risks to health by contraction through an open wound or through swimming were mentioned only once.

Risks to fish populations were most concerning of natural environment risks (n=34). Other perceived risks included risks to fish in general (n=32), fish kills (n=23), disease spread between fish (n=21), general risk to the rest of the environment (n=20), food webs (n=14), birds (n=9), spread to other animals (n=9), fish health (n=5), and fish reproduction (n=3). These risk perceptions were represented by the following quotes:

> "I would say fish. I don't know... I guess this is the first time I've heard of it but, fish populations, health of fish, reproduction of fish" (B5).
> "... I assume it kills birds too when they eat the fish" (R1).

> "Well I would assume that it might upset the system. Meaning if there's small fish and they die out, then the larger fish don't have their prey and it snowballs down the line" (H1).

For risk perceptions of VHS and its management to economic livelihood, respondents expressed concern about risks to people who fish for a living (n=8). One participant shared:

> "I have some friends that run a charter boat, you know, if they can't fish they're not making money. I haven't heard that it has impacted them yet but, they haven't even talked about it really so it must not be bothering them too much out in the big lakes, so, out in Michigan. What I've heard as it's been in inland lakes, hasn't it? Mostly? Like, Harrison area, they had like Budd Lake was full of it. And a lot of people fish that, so I'm sure it hurt their economy quite a bit, for a while" (P6).

Few people felt that VHS or its management posed a risk to their livelihood (n=5). Other respondents stated that there was no risk posed to how they financially support themselves.

Two participants shared their concerns to their livelihood, saying: "Well if it fails completely and the fishing goes completely to pot, yes, it would have a definite impact on my economic livelihood" (C4). "Yes, I have thought about that. I am a fishing guide, and if this was to get widespread, it would impact me economically" (SSM9). Some participants were also concerned for the livelihoods of others (n=7). Another participant shared their concern, stating, "Their failure to react quickly will have an economic impact on them. Loss of jobs, loss of livelihood, businesses lost" (H16).

Respondents perceived a negative impact on fishing in general when asked about risks to fishing (n=19). This concern was elaborated by a participant, stating, "Yeah, I think that would cause a problem if word got out that there were diseased fish in there. I mean, if I didn't know much about it but heard the fish were diseased with something, I wouldn't go fishing" (B10). Other risk perceptions were held for recreational (n=20),

commercial (n=18), and sport fishing (n=15). Additional perceived risks included reduced fishing effort (n=11), there would be no fish to catch (n=7), and people may have to stop fishing (n=6).

Perceived risks to the culture of fishing included tourism in Michigan (n=22), to the fishing industry (n=20), to the economy in general (n=15), to restaurants (n=7), and to future fishing (n=6). The importance of the industry in the Upper Peninsula was explained: “The U.P. relies on Native American fishing for subsistence and commercial fishing. There aren't a lot of industries in the U.P.; that's one of them” (H7). One participant explained tourism in the state and fishing: “Michigan's a big tourism industry, and I know that we attract a lot of out state fishermen, and if we get a, even for Michigan residents, if we get a rap for having fish with diseases, they're not going to come here and fish” (SSM10). A participant gave a thorough explanation of the fishing culture in the Upper Peninsula, stating:

> “Literally every tourist sign at every shop in Hessel, Cedarville, any of these areas along the coast have like "gone fishing" signs, they're literally- the whole culture up here is fishing culture, you know, and people have been fishing and boating here since the town was born you know. You can actually- a bit of history- you can actually look at the first maps from the French were already marking fishing spots and that's in the early 1600s you know so this whole like, this whole place is based upon that and has been based upon that for a long time” (H3).

Respondents were concerned about the use of chemical treatment (n=11) and stricter regulations (n=7) for VHS management. Risk perceptions of chemical treatment included the statement, “Don't treat it with chemicals cause that's typically, they treat stuff and then it gets worse- affects other species” (H4).

Participants also stated that management was a benefit (n=20), there were risks from not managing VHS (n=18), and management should minimize risk (n=8) One participant described management as a benefit stated:

> "I don't. No, I'm sure there will be people that will say, "Oh you're going to make regulations that makes it harder for me to catch fish, make it less fun for me to fish, make me do things I didn't want to do." But I don't see those as threats, those are necessary costs. So, I don't see management as a risk" (P2).

Trust in the Michigan Department of Natural Resources Fisheries Division was mostly positive, or in agreement with each of the closed-ended items. Participant response distributions and means are shown below (Figure 3.7 and Table 3.1). The item with the highest mean is that the MDNR information is believable, at 4.07 (SD=0.60). The item with the lowest mean is the statement that the MDNR provided enough information to make decisions about taking action to slow the spread of VHS and other fish diseases, with a mean of 2.98 (SD=1.10), meaning just below a "Neutral" response.

Figure 3.7. Trust in MDNR Fisheries Division (N=80).

Table 3.1. Mean, standard deviation, Eigen values and percent of variance captured by trust items[1]

The Michigan Department of Natural Resources…	Mean	Standard Deviation	Number of Respondents (n)	Factor Analysis Eigen Value	Factor Analysis % of Variance
Information about VHS is believable	4.07	0.60	56	.385	7.705
Can be trusted to provide the best available information about VHS	3.80	0.96	70	.966	19.316
Can be trusted to make good management decisions regarding VHS	3.77	0.91	69	.323	6.457
Provided lots of opportunities to listen to individuals' concerns about VHS	3.29	1.10	45	.156	3.117
Provided enough information to make decisions about taking action to slow the spread of VHS and other fish diseases	2.98	1.10	50	3.170	63.406

[1]Means, standard deviations, and numbers of respondents calculated using a 1 to 5 "Strongly Disagree" to "Strongly Agree" scale and excluding "Don't Know" responses.

The trust items were also analyzed as a scale. Factor analysis Eigenvalues of 3.170 for component 1, MDNR provided enough information to make decisions about taking action to slow the spread of VHS and other fish diseases, and scores of 0.966 and below for components 2 through 5 suggest that the scale is indeed capturing one latent trust factor. Reliability analysis results of the trust scale are below (Tables 3.2 and 3.3).

Cronbach's Alpha for the five trust items was 0.844, which indicates a high level of internal consistency.

Table 3.2. Trust scale reliability statistics

Cronbach's Alpha	N of Items
.844	5

Table 3.3. Trust scale item-total statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
MDNR Enough Info	15.065	10.662	.546	.842
MDNR Best Info	14.484	9.458	.820	.763
MDNR Believable	14.129	12.716	.581	.840
MDNR Decisions	14.419	9.785	.627	.822
MDNR Opportunities	14.935	9.462	.761	.779

Elaborating on their trust in the MDNR Fisheries Division and their fish disease management, some participants explicitly used the word trust, many participants said they had trust (n=36), while fewer participants shared that they had little trust in the MDNR Fisheries Division (n=13). Negative perceptions included, "I don't believe that their rules and regulations are based on what's better for the environment or the fish, it's based on money. I participated in a survey I don't know, there years ago, whatever it was. Anyways, it thought it was bogus, they go by public opinion, not what's scientific" (R7). Other participants elaborated positively on MDNR Fisheries Division– they are doing a good job (n=26), they are educated (n=4), and they are the professionals (n=3). One participant elaborated, "I guess the Fisheries Division I've got a lot of respect for. A good portion of the fish I catch are planted, and without the fisheries people, tribal included as well as- that really has an awful lot to do with the good fishing that I have, so I think a lot of them. Now if you want to talk about wildlife, then I wouldn't have nothing- you'd have

to turn that [referring to recording device] off. But I think they do a pretty good job in the fisheries" (B8).

Influences of trust in the MDNR Fisheries Division and their fish disease management included personal experiences (n=40)– both positive and negative. Speaking positively, one participant shared, "Well, I believe that they've researched it, and they know- they're aware of what's going on and I think that they'll, you know, try to put something in place to help with the fish- help the fish based what I know about Hammond Bay Biological Station" (C1). Participants also mentioned interaction with MDNR employees (n=12), politics (n=8), seeing results from the MDNR (n=7), and the hope that the MDNR Fisheries Division knows what they are doing (n=7).

Although the interview guide stated "MDNR Fisheries Division," it seemed that there was little separation of MDNR divisions for some participants. Trust and opinions shared involved other divisions such as the Wildlife Division and the Law Enforcement Division. Some participants talked about deer management (n=5) and wolf management (n=4)–which are contentious issues in the Upper Peninsula. One participant shared their mixed trust as, "There's a major lack of trust in the DNR from me. So, that relates, you know, to wolves and deer management and stuff, so it kind of wanders over here into the fish, so I'm just hoping they do something" (B6). Other participants mentioned characteristics of the Law Enforcement Division, such as conservation officers (n=6) and being ticketed (n=4).

In addition to risk perceptions and trust variables, the interviews also asked concern of fish diseases in the Great Lakes and Michigan's inland lakes. All 80 participants expressed at least slight concern for the Great Lakes, while all but one

participant, who chose not to answer, expressed at least slight concern of fish diseases in inland lakes. A majority of interview participants were moderately or very concerned about fish diseases, 76% (n=61) for the Great Lakes and 79.9% (n=64) for Michigan's inland lakes. Of the 80 participants, 20% (n=16) had never thought about fish diseases in the Great Lakes before, while 13.8% (n=11) hadn't thought about fish diseases in Michigan's inland lakes. All responses can be seen below (Figure 3.8).

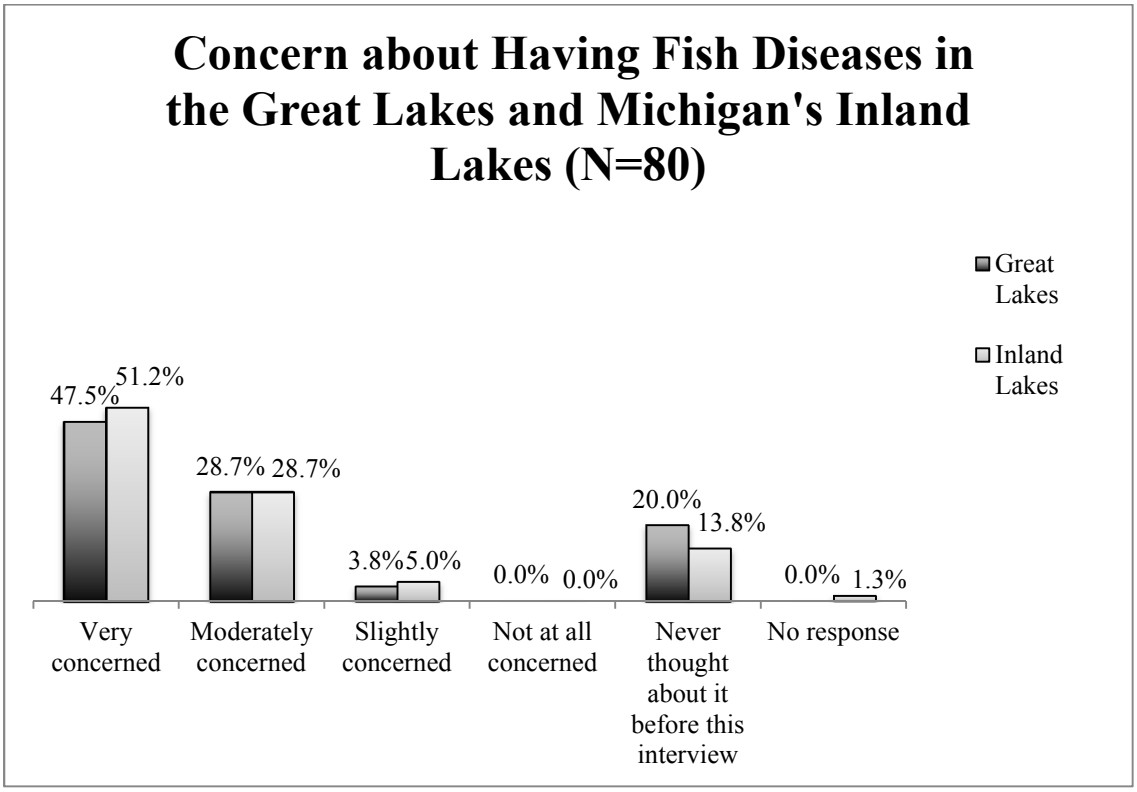


Figure 3.8. Concern about having fish diseases in the Great Lakes and Michigan's inland lakes.

Interviews also asked whether or not participants had heard of the disease viral hemorrhagic septicemia or VHS; if they recognized the name but didn't know much about it, or if they recognize the name and know something about it. The responses of the participants can be seen below (Figure 3.9). Of the 80 participants, 57.5% (n=46) had never heard of the disease, while 27.5% (n=22) people had recognized the name but

didn't know much about it. Only 15% (n=12) of respondents felt that they recognized the name and knew something about it. Overall, 85% (n=68) of participants had not heard of VHS or didn't know much about it.

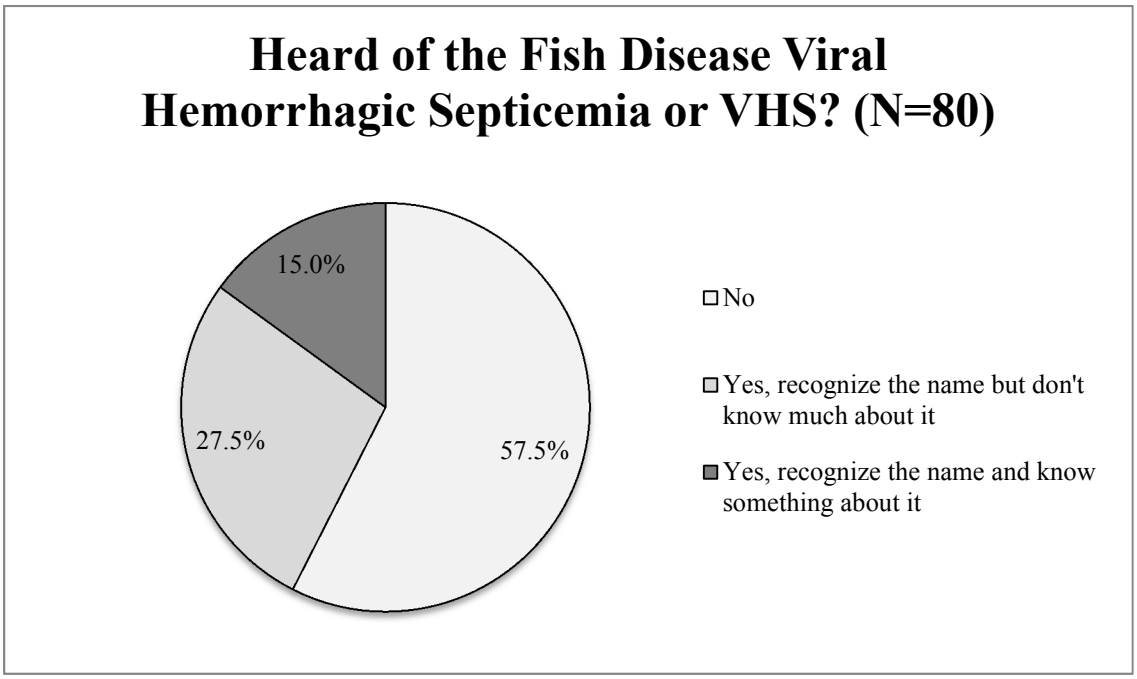


Figure 3.9. Responses of the 80 participants to the question if they had heard of the fish disease viral hemorrhagic septicemia or VHS.

Despite their lack of knowledge about VHS, participants mentioned other invasive species (n=21), especially Asian carp (n=14). Very few participants mentioned of other fish diseases (n=2). Hearing of VHS (yes or no) was significant in participants' top concern of risk of VHS to fishing (p=0.035, FET) and risk of VHS management to the environment (p=0.049, FET) using Fisher's Exact tests (Tables 3.4 and 3.5).

Table 3.4. Crosstab for Fisher's Exact test in risk to fishing from VHS

		Top Concern of VHS Fishing		
		No	Yes	Total
Heard of VHS	No	39	7	46
	Yes	21	13	34
Total		60	20	80

Table 3.5. Crosstab for Fisher's Exact test in risk to the natural environment from VHS management

		Top Concern Management Natural Environment		
		No	Yes	Total
Heard of VHS	No	28	18	46
	Yes	28	6	34
Total		56	24	80

Addressing the study hypotheses, trust did not have an influence on risk perceptions of VHS or its management, so we fail to reject the null hypothesis (no difference) of Hypothesis 1 at level $\alpha=0.05$, although at level $\alpha=0.10$, trust becomes significant in perceived risk of VHS to the natural environment. Fisher's Exact test results for each risk variable are shown below (Table 3.6).

Table 3.6. Fisher's Exact test p-value results (High/low trust by yes/no risk type)

Risk Type	Top Concern (Risk) of VHS	Top Concern (Risk) of VHS Management
Health	p=0.494	p=0.383
Natural Environment	p=0.087[1]	p=0.489
Economic Livelihood	p=0.815	*
Fishing	p=0.288	p=0.113
Culture of Fishing	p=0.221	p=0.617

* No participants chose risk to their economic livelihood as their top concern of VHS management.
[1]Significant at level $\alpha=0.10$.

In addition, one-way ANOVA tests were used for mean trust, which was normally distributed, by grouped top concerns of VHS. Risks were grouped into "Personal" (health and economic livelihood), "Environment" (natural environment) and "Fishing" (fishing and culture of fishing) for both VHS and VHS management. ANOVA results are shown below (Table 3.7). Degrees of freedom change dependent on those respondents who had a mean trust calculated and if they responded to the top concern of VHS and VHS

management items. Overall, there are no significant differences of mean trust between categories of grouped top perceived risks of VHS and its management.

Table 3.7. One-way ANOVA results of mean trust grouped by personal, environment and fishing top concerns for VHS and VHS management

	Sum of Squares	df	Mean Square	F	Sig.
VHS Risks					
Between Groups (Personal, Environment, and Fishing top concerns)	1.485	2	.742	1.724	.187
Within Groups (All respondents that had a mean trust score)	26.271	61	.431		
Total	27.756	63			
VHS Management Risks					
Between Groups (Personal, Environment, and Fishing top concerns)	.580	2	.290	.571	.568
Within Groups (All respondents that had a mean trust score)	28.454	56	.508		
Total	29.035	58			

Also, there were no significant differences between management areas in mean trust of participants. Management area type of participants who responded in a way to be calculated a mean trust score– Positive (n=21), Surveillance (n=20), and Free (n=24)– did not yield any significant differences in mean trust using a one-way ANOVA test ($F(2,64)=0.626$, $p=0.538$), so we fail to reject the null hypothesis (no difference) of Hypothesis 2. There were three outliers in the mean trust variable as assessed by boxplot–

one per management area– but they were included in the test as they did not change the overall result of no significance (F(2,61)=0.073, p=0.930 without outliers). The one-way ANOVA table is shown below (Table 3.8).

Table 3.8. Mean and standard deviation of mean trust scores and one-way ANOVA results of mean trust by management area

	Mean	Standard Deviation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups (Positive, Surveillance, and Free Management Areas)	Positive 3.594 Surveillance 3.780 Free 3.554	Positive .691 Surveillance .477 Free .856	.621	2	.310	.626	.538
Within Groups (All respondents that had a mean trust score)	3.636	.700	30.749	62	.496		
Total			31.370	64			

Discussion

This research gives insight into the ZDRISP model in an aquatic context and determines levels of risk for VHS and its management held by aquatic-based recreational in Michigan, and how levels of trust in the MDNR Fisheries Division plays a role in their concerns. From testing trust, we learned that this introduced variable is not significant level $\alpha=0.05$ in perceived risks of VHS and VHS management, but were able to show that trust and perceived risk to the natural environment was significant at level $\alpha=0.10$. More participants with high trust did not express their top concern as the natural environment. From analyzing the trust scale, 82.7% of the variance within the scale was composed of

two items– the MDNR provided enough information and the MDNR provided the best information. These two items alone could be used to measure trust in future studies.

Also, we know that trust does not significantly differ between VHS management areas. As VHS management areas are no longer used for regulations of the disease beginning in 2016, it is a positive finding for managers and means that more effort does not need to be put into certain areas for trust building activities regarding fish disease management of the MDNR Fisheries Division.

It is important to note that although the interview guide stated "MDNR Fisheries Division," it seemed that there was little separation of MDNR divisions for some participants. Trust and opinions shared involved other divisions such as the Wildlife Division and the Law Enforcement Division. It is important the Fisheries Division make distinctions of the division roles in their communications, especially with the Law Enforcement Division, as the conservation officers are the employees that are out on the water and usually interacting with aquatic-based recreational users most often.

Despite no significant findings for the study hypotheses at level $\alpha=0.05$, this research contributes to the greater understanding of perceived risks of VHS and its management. As a majority of participants did not know about VHS, it is possible that this information about stakeholder risk perceptions can help practitioners communicate broadly about fish diseases in the future. Knowing what aquatic-based recreational users instinctively care about with little to no knowledge about the disease can help define the content of risk communications for the MDNR Fisheries Division, as perceived risks of other fish diseases could be similar to those held for VHS.

In addition, many participants had not heard of VHS, while they had heard of other invasive species, such as Asian carp. Future aquatic invasive species messaging by natural resource agencies could include more emphasis on pathogens, especially if there are certain diseases that pose a greater risk to entering the Great Lakes at that time. As hearing of VHS is significant in the concern of VHS to fishing and VHS management to the natural environment, including pathogens on signage at aquatic-recreation access locations is recommended.

Limitations and Future Research

While this study explored stakeholder perceptions through qualitative semi-structured interviews, there was a relatively small, as well as a convenience sample size, and results should not be generalized to other states. Other data collection methods that allow for large sample sizes should be employed to better generalize results. Also, as the interviews were listened to for themes, it may introduce some bias as audio quality may not be consistent or the researcher's ability in listening may differ between male and female voices, or listener fatigue.

Viral hemorrhagic septicemia was used as a case study and although it may have a variety of impacts on human activities, it does not cause disease in humans. Future research could expand the understanding and efficacy of the model by testing it with truly zoonotic aquatic diseases. The nature of risks associated with VHS is also known as impersonal risk—"risks that threaten something other than the self"— and further research should be conducted to explore the nature of this type of risk within the ZDRISP model (Kahlor et al., 2006). Also, VHS has already been around for over a decade in Michigan; prospective research could use a newly emergent aquatic disease. Despite its

longevity in the Great Lakes, respondents were still concerned about VHS spread from Great Lakes to inland lakes in Michigan and prospective research could study information seeking behaviors for users at VHS infected inland lakes to help best communicate possible VHS spread in the future.

As the interviews used in this study tried to reduce respondent fatigue while still achieving the outlined objectives of the research, future research could also include a more comprehensive set of quantitative items for investigating each type of risk perceived for VHS and VHS management. Likert scale responses could be used for each type of risk instead of participants choosing only their top concerns for VHS and its management.

Regarding the trust attribute– as trust responses were collected in Michigan in summer 2015, trust may have decreased in state government entities since that time, with the advent of public media coverage of the Flint water crisis in early 2016. Although the Michigan Department of Environmental Quality was the regulating authority in that situation, we may not know how this has affected trust in the DNR Fisheries Division. Finally, as only the relationship between agency trust and perceived hazard characteristics was examined in this thesis research, future research should also include other attributes of the ZDRISP model to seek a more holistic understanding of attribute relationships in an aquatic context.

CHAPTER 4

COMMUNITY ENGAGED RESEARCH OF GAIN AND LOSS FRAMED MESSAGES ABOUT FISH DISEASES IN MICHIGAN: INSIGHTS FOR STATE AGENCY MANAGERS AND PRACTITIONERS

Abstract

Gain and loss framing has been used as a technique in risk communication to shape individuals preferences or actions in many fields, especially health communication, but has also been studied in other contexts– including environmental actions. This study, conducted in partnership with the Michigan Department of Natural Resources (MDNR) Fisheries Division and Michigan Sea Grant Extension through the Michigan State University Graduate Certification in Community Engagement program, used structured interviews with attendees (n=82) at events and expos with MDNR outreach booths in order to gain insight into how best the Fisheries Division could frame their messages about fish diseases, as the use of outreach communications campaigns can be a promising tool in disease management. This study tested five communication messages on the effects of gain and loss framing in a newly tested context of fish disease and fish disease management. Results yield that there were no significant differences between gain and loss framing in regards to risks to the natural environment in the context of fish disease and fish disease management. Yet, participation in various aquatic-based recreational activities may influence participant responses such as their behavioral intentions to learn more about fish disease and follow the laws and recommendations to slow its spread. I believe that there is more to be explored with gain and loss framing in the context of fish disease and future research is discussed.

Introduction

State natural resource agencies around the country communicate with stakeholders about risks related to numerous issues (e.g. changing climate to fish diseases) that vary in their nature and impact (Alaska Department of Fish and Game, 2011; California Natural Resources Agency, 2014; Michigan Department of Natural Resources, 2016c). In Michigan, as a state with vast freshwater resources, fisheries and their health are important to the agency and the state economy, as well as those who recreationally or commercially fish, eat Great Lakes fish, or may just value fisheries intrinsically.

Fishing is a popular activity in the Great Lakes states, which comprised 17% of the country's total fishing participants in 2013 (Recreational Boating & Fishing Foundation & The Outdoor Foundation, 2014). In Michigan, many residents of the state participate– in 2013, 978,067 in-state fishing licenses, tags, permits and stamps were sold in Michigan, which represented about 10% of the state's population at the time. (U. S. Census Bureau, 2014; U.S. Census Bureau, 2016; U.S. Fish and Wildlife Service, 2013). Fishing also makes an impact on Michigan's economy. Anglers who fished in Michigan spent 2.4 billion dollars in 2011; expenditures which included trip-related purchases, fishing and other equipment, and purchases of licenses, magazines, land leasing, etc. (U.S. Department of the Interior et al., 2011) In 2013, Michigan commercial fishery production dockside value was estimated at over fourteen million dollars (Michigan Department of Natural Resources, 2013). After these fish are processed and sold, the economic impact is estimated at four to five times the dockside value (Goniea, 2014).

With so much at stake in the state's fisheries, the Michigan Department of Natural

Resources (MDNR) communicates regularly about fishing regulations, hatcheries and fish stocking, invasive species, and fish diseases that may threaten fish populations (Michigan Department of Natural Resources, 2015b, 2016b, 2016c, 2016e).

In the interest of gaining knowledge in the application of risk communication approaches in a natural resources context, a partnership was developed between a graduate student, the MDNR Fisheries Division, and Michigan Sea Grant Extension through the Michigan State University Graduate Certification in Community Engagement program in order to gain insight into how best the agency division could frame their messages about fish diseases, as the use of outreach communications campaigns can be promising in disease management (Triezenberg et al., 2014b). After an initial meeting with my partner, a promotional agent in the Fisheries Outreach and Education group within the MDNR Fisheries Division, to discuss what might be helpful for the MDNR Fisheries Division, it was decided that gain and loss framing of risk of fish disease would provide fruitful insights for the division's future communication efforts.

The Michigan State University Graduate Certification in Community Engagement program is offered in partnership of MSU's University Outreach and Engagement and The Graduate School, and helps graduate students develop "systemic, respectful and scholarly approaches to their community engaged work" in the realm of "engaged research and creative activities, engaged teaching and learning, engaged service, and/or engaged commercialization activities" (University Outreach and Engagement, 2016). Through the program, participants "demonstrate core competencies, value outreach and engagement as a scholarly activity, put their scholarly and practical skills into practice in a community setting, and critically reflect on their community engagement experiences"

(University Outreach and Engagement, 2016) This community engaged research study satisfied the requirements of a 60-hour mentored community engagement experience, demonstrated scholarly engagement, and involved community engaged research (Doberneck et al., 2010; Glass & Fitzgerald, 2010). This project was a good example of the community engagement philosophy as I worked with a partner that works in and for a community of anglers and other aquatic-based recreational users and I delved into this community through my community-engaged research that used scientific rigor.

Through the community engagement program partnership, I conducted research with the objective to investigate the effects of gain and loss framing– if gain or loss framed messages about fish disease and disease management influenced stakeholders' in perceptions, beliefs, trust in the MDNR Fisheries Division, and actions that the MDNR Fisheries Division and other natural resource agencies hope that their stakeholders will take in order to protect fisheries resources from risk or harm.

Gain and Loss Framing

Tversky and Kahneman (1981) showed that the positive or negative framing of a decision could change individual preferences (Tversky & Kahneman, 1981). In risk communication, risks can be framed as either gains or losses, meaning that they can be described positively as a gain, such as, "There is an 80% chance of survival." Alternatively, risks can be described negatively as a loss, such as, "There is a 20% chance of death." It is important that gain frames can both describe "the good things that will happen and the bad things that will not happen", as well as loss frames describe "the bad things that will happen as well as the good things that will not happen" (Rothman et al., 2006). Gain and loss framing is a type of outcome framing, as it is used as an approach to

persuade adoption of certain actions or behaviors (Spence & Pidgeon, 2010). It is a common technique and can enhance the probability of a communication campaign's success (Randolph & Viswanath, 2004).

Since the research in framing of decisions by Tversky and Kahneman (1981), framing in communications research has come a long way, although it does not seem clear which frame, gain or loss, is most effective across situations, and especially in environmental or natural resource-related issues. For low-risk preventative behaviors in the context of human health, a review of literature has suggested that gain frames will be slightly more effective for adoption of dental hygiene behavior, while there is no significant effect for other gain and loss framed persuasive messages about behaviors for safe-sex, skin cancer prevention, or diet and nutrition (O'Keefe & Jensen, 2007). Yet, loss frames in conjunction with losses to the current generation were more effective in communicating about environmentally-responsible behaviors, like recycling (Davis, 1995). Other studies have investigated the effects of gain and loss framing in fields such as climate change. One study suggests gain framing was more effective for increasing positive attitudes toward climate change mitigation (Spence & Pidgeon, 2010). Like this research, another study by Lu (2016) focuses on an aquatic disease– sea star wasting disease– but investigates effects of emotional appeals versus gain and loss framing. This research suggests that when using a gain frame, a sadness appeal is more effective for information seeking intentions and intentions to adopt pro-environmental behaviors, and in a loss frame, a hope appeal is more effective for information seeking intentions (Lu, 2016). As the effectiveness of framing seems to be context specific, this research sought to determine which frame, gain or loss, is most effective for communicating risks of fish

disease.

Currently in 2016, a widely used message by the MDNR Fisheries Division about viral hemorrhagic septicemia (VHS) and other fish disease best practices is "Help Michigan's waters stay world class, put unused bait in the trash!" This phrase has been used online, at MDNR outreach booths, as well as in the 2016-2017 Michigan Fishing Guide (Michigan Department of Natural Resources, 2016a, 2016d). In the development of this message, the MDNR Fisheries Division incorporated "world class," as it was an informal designation the state had received from many entities and the division felt the message "put the power in the hand of the individual recreating to maintain that designation" (Walter, 2016a). An online image from the MDNR website is shown below (Figure 4.1). This example can be viewed as a gain frame, because it communicates that performing the action of throwing unused bait in the trash will lead to a positive outcome, which is helping keep Michigan's waters stay world class. An example of possible loss framing of this message would be that, "We will lose the quality of Michigan's waters if you don't throw away unused bait in the trash."

Figure 4.1. An example of MDNR VHS messaging using a gain frame (Michigan Department of Natural Resources, 2016d).

The research objective was to investigate the potential effects of gain and loss framing in communicating about fish disease and its management– to investigate the effects of gain and loss framing; if gain or loss framed messages about fish disease and disease management influenced stakeholders' risk perceptions of fish disease risk to the natural environment and fisheries and their trust in MDNR Fisheries Division communications, as well as their behavioral intentions to seek more information, to follow the laws and best practice to slow the spread of fish diseases, and to learn more about MDNR Fisheries Division's fish disease management. As a result, the following hypotheses were formulated and tested:

> Hypothesis 1: Gain framing of risk in the context of fish disease and fish disease management will be more effective in increasing a) risk perceptions of disease and disease management; b) positive behavioral intentions to learn more about the subject and follow the laws and recommendations to reduce the spread of fish diseases; and c) trust in MDNR communications.

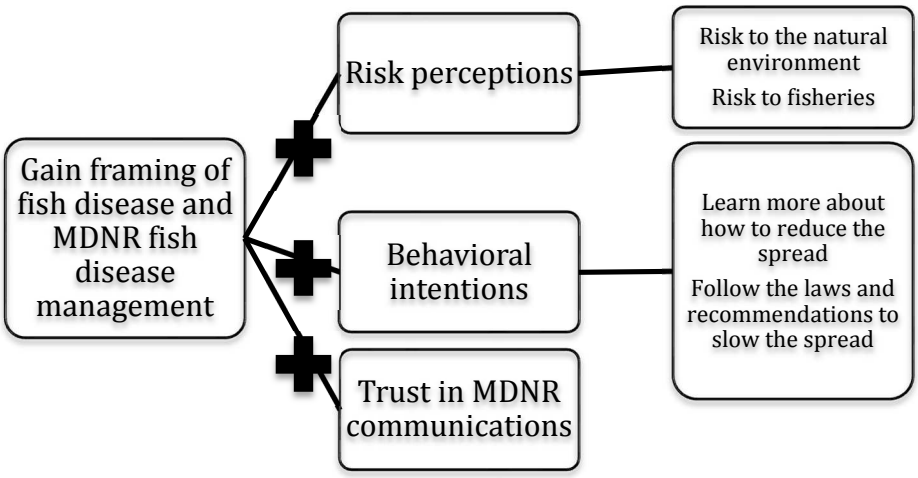


Figure 4.2. Alternative hypothesis of the community-engaged research.

Methods

This research used structured interviews as the basis for data collection. Interview responses were anonymous as they were recorded with only an identifying code of letters and numbers used to keep all responses linked to one participant. After the interview was complete, I asked if they would like to enter the incentive drawing. Contact information collected for the drawing was kept separate from completed interview guides and was kept confidential to only the MSU IRB approved investigators. The sample frame for the interviews included attendees aged 18 years or older at four events with scheduled DNR booths, which was coordinated through my partnership with the MDNR Fisheries Division and a department specialist in the Marketing and Outreach Division.

Data were collected at four events: the Grand Rapids Boat Show in Grand Rapids, MI, Outdoorama in Novi, MI, West Michigan Women's Expo in Grand Rapids, MI, and the Ultimate Sport Show in Grand Rapids, MI. Each event had a DNR outreach booth scheduled. I collected data at these events on Saturdays and interviews were scheduled in two three-hour shifts— from 10am-1pm and 2pm-5pm. The methods of this research were reviewed and approved by the MSU Institutional Review Board (IRB) (#x15-651e) on February 18, 2016 (See Appendix E).

I approached potential study participants in person, inviting them to voluntarily participate in the study and informed them of an incentive opportunity to win one of five $20 Meijer gift cards for completing an interview. If the participant agreed, a verbal consent process was read that introduced myself and the background of the research study, and that they could opt out of the interview at any time, and after I initialed that

they gave consent. I completed a data sheet for each respondent, manually recording his or her responses.

The interview guide (See Appendix D) was developed in partnership with members of Michigan Sea Grant Extension and the MDNR Fisheries Division via participatory editing. Participatory editing is a technique from Wates (2000), *The Community Planning Handbook*. It is a process where a document is distributed for comment, and participants mark up the document, then send it back to the editor, who then makes the changes (Wates, 2000). After drafts were reviewed and edited, the final draft of the guide began with a general inquiry of aquatic-based recreation activities people participated in via yes/no questions and a Likert scale of awareness of laws and recommendations to slow the spread of fish diseases and current behaviors of taking actions to slow the transmission of fish diseases.

Following the questions used in the study by Lee et al. (2015) as suggested in the development of the community-engaged research partnership, these actions included: draining livewells, bilges and all water from their boat before leaving access sites, disinfecting livewells and bilges with a bleach solution, disposing of unused (live) fishing bait on the land or in the trash, power washing their boat, paddling equipment, and trailers, and drying boats and paddling equipment for at least five days before launching in other waters. Response options were also consistent with Lee et al. (2015)– a scale of never, seldom, sometimes, often, and always were employed, with a "not applicable" option added, as some participants may not own a boat or paddling equipment.

The design of this research is a 2x2 factorial design with a control, and is depicted below (Table 4.1). Overall, there were five different messages on printed PowerPoint

slides: A gain frame in a disease context, a loss frame in a disease context, a gain frame in a disease management context, a loss frame in a disease management context, and a control message that was neither gain or loss framed (See Appendix C). These messages were created via participatory editing with a participant from the MDNR Fisheries Division and a member of my graduate committee. Each participant viewed only one message per interview and messages were shown to participants in rotation, one through five throughout interviewing days.

Table 4.1. 2x2 factorial design with control for research design.

	Frame		
	Gain Frame	Loss Frame	
Context of Perceived Risk	Disease	Disease	Control
	Gain Frame	Loss Frame	
	Disease Management	Disease Management	

After being exposed to a message (printed from PowerPoint), each participant was asked about their level of agreement using Likert scales to statements regarding behavioral intentions to seek more information about how they can reduce the spread of fish diseases and to follow the laws and recommendations to slow the spread of fish diseases, beliefs of risk to the natural environment and fisheries from fish diseases, and trust in the DNR message. The interview guide was structured to ask belief, behavior, and trust questions after the message only– not before and after– in an attempt to reduce

social desirability bias– the need for people to show individual improvement (Lee et al., 2015).

To conclude, demographic questions were asked, including if the person was male or female, the year they were born, their level of education, 2015 household income, and city and state of residence. At the end of the interview, the participant had the choice to provide their contact information on a separate card to enter the drawing for the gift card incentive.

To test Hypotheses 1 and 2, Kruskal-Wallis H tests were used, as the sample size for each message shown was small, and the test allows for more than two independent groups to be tested on ordinal-scale dependent variables. As each participant only viewed one framed or control message, there were five independent groups for hypothesis testing– one for each message (gain/disease, loss/disease, gain/disease management, loss/disease management, and control). Other independent grouping variables used for other Kruskal-Wallis H tests were education level, 2015 household income level, and the event attended. Mean ranks are compared in the Kruskal-Wallis H tests, meaning that higher values within the group are assigned higher ranks, and as "Agree" and "Strongly Agree" are valued at 4 and 5 respectively, higher mean ranks correspond to higher positive responses. Mann-Whitney U tests were used as well for grouping variables that had only two categories– gender (male/female) and participation in five different aquatic-based recreational activities (yes/no).

The dependent, or response, variables tested were: seeking more information to reduce the spread of fish diseases, intention to follow the laws and recommendations to slow the spread of fish diseases, the beliefs that fish diseases pose a risk to fisheries and

the natural environment (also known as risk perceptions), the desire to learn more about DNR Fisheries Division's fish disease management, and trust in the DNR communication shown.

Results

Eighty-two interviews were completed in total. Those who declined interviews either did not have interest or time to participate. Overall, 28% (n=23) of interviews were conducted at the Boat Show in Grand Rapids, MI, 30.5% (n=25) were conducted at Outdoorama in Novi, MI, 30.5% (n=25) were conducted at the West Michigan Women's Expo in Grand Rapids, MI and 11% (n=9) were conducted at the Ultimate Sports Show in Grand Rapids, MI.

Interview participants were 48.8% (n= 40) male and 51.2% (n=42) female and averaged 55 years of age (n=81, SD=12.42). All but one participant (n=81) had at least a high school diploma, 25.6% (n=21) had completed some college or technical school, 25.6% (n=21) had an undergraduate degree, and 20.7% (n=17) had a graduate or professional degree. Almost fifteen percent (n=12) reported a 2015 household income of less than $40,000 before taxes. Over twenty-nine percent (n=24) earned a household income of $60,000-100,000. About fifteen percent (n=12) earned a household income of $120,000 or more. Over thirteen percent (n=11) preferred not to reveal their 2015 household income. All but one participant, 98.8% (n=81), resided in Michigan. The distribution of residences within Michigan and Illinois is shown below (Figure 4.3). Sociodemographic variables of participants are summarized below (Table 4.2).

Table 4.2. Sociodemographic characteristics of participants

Variable	Percentage/Average	Standard Deviation
Gender	48.8% Male, 51.2% Female	

Table 4.2. (cont'd).

Age	55 years	12.42
Education		
Less than high school	1.2%	
High school diploma or GED	12.2%	
Some college or technical school	25.6%	
Associate's degree	14.6%	
College undergraduate degree	25.6%	
Graduate or professional degree	20.7%	
Income		
$40,000 or less	14.6%	
$40,000-60,000	15.9%	
$60,000-80,000	20.7%	
$80,000-100,000	8.5%	
$100,000-120,000	12.2%	
$120,000 or more	14.6%	
Prefer not to answer	13.4%	
State of Residence	98.8% MI, 1.2% IL	

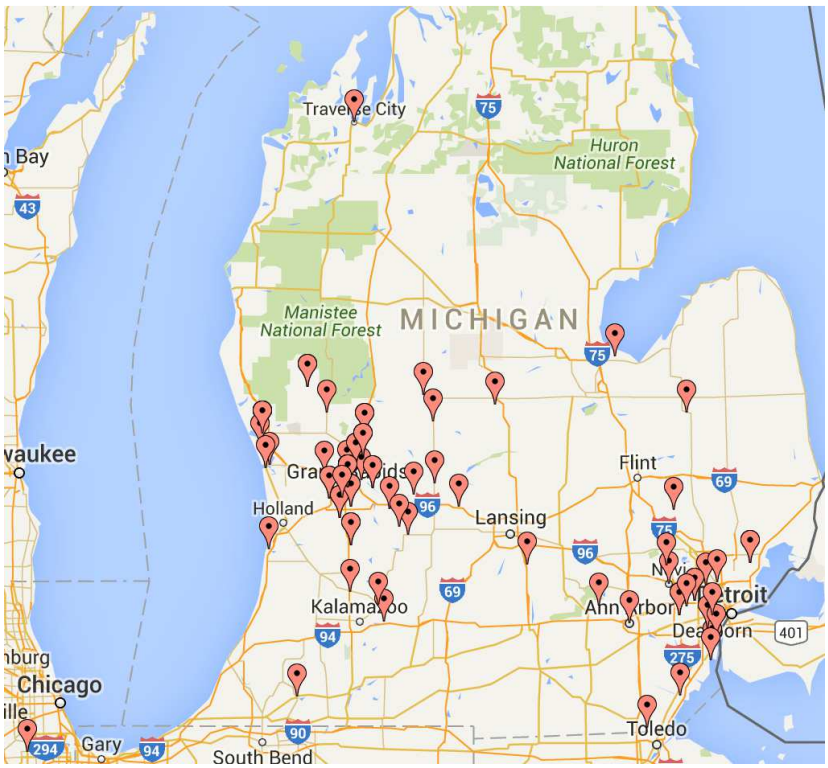


Figure 4.3. Participants' cities of residence within Michigan and Illinois. Map created using BatchGeo (BatchGeo LLC, 2016).

Interviewees reported participating in various aquatic-based recreational activities, with recreational boating and fishing from land or shore being the activities tied with the highest participation with 78% (n=64) participation. Fishing from any type of boat, canoe, or kayak had the second highest participation with 73.2% (n=60), followed by recreational paddling, with 61% (n=50). Personal watercraft was the lowest, with only 14.6% (n=12) participants responding they participate in the activity. These data are shown below (Figure 4.4).

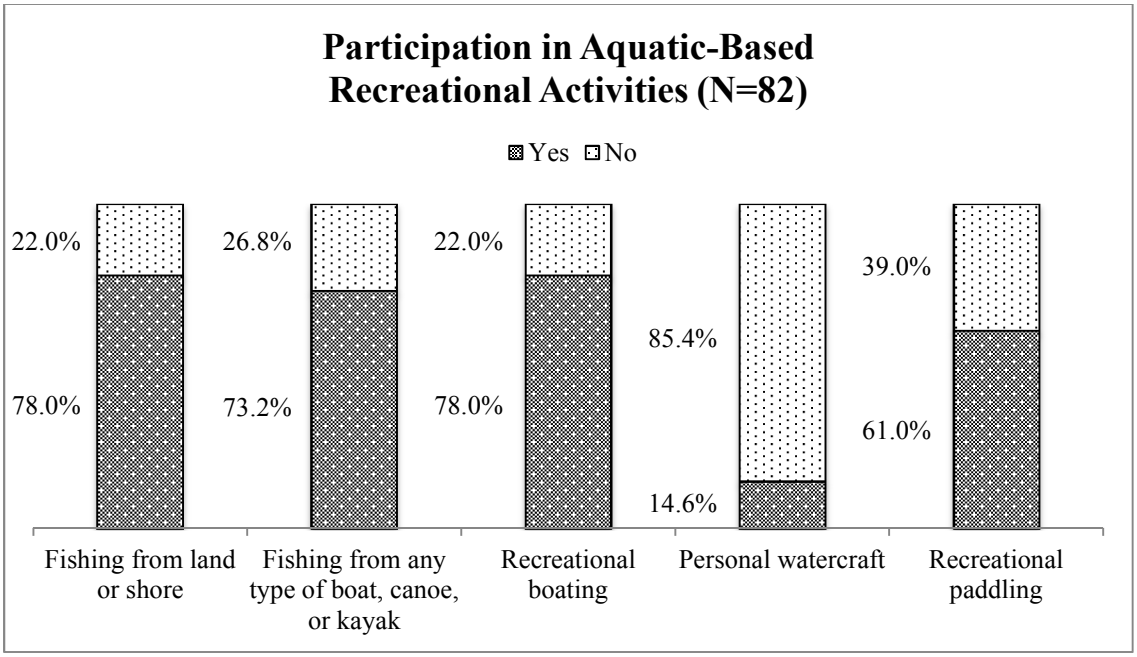


Figure 4.4. Participation in aquatic-based recreational activities (N=82).

Investigating awareness of laws and recommendations that are in place to protect against fish diseases in Michigan, I found that the majority of participants either agreed or strongly agreed (n=49). Over forty-five percent (n=37) agreed that they were aware and almost fifteen percent (n=12) strongly agreed that they were aware of the laws and recommendations. Over 23% (n=19) strongly disagreed or disagreed that they were aware of the laws and recommendations. These data are shown below (Table 4.3).

Table 4.3. Participant level of agreement that they are aware of the laws and recommendations to protect against fish diseases in Michigan

Response	Number	Percentage
Strongly Disagree	5	6.1%
Disagree	14	17.1%
Neutral	14	17.1%
Agree	37	45.1%
Strongly Agree	12	14.6%
Total	82	100.0%

Most actions to prevent the spread of fish disease had a positive response– 41.4% (n=34) often or always drained their boats or paddling equipment, 37.8% (n=31) often or always disposed of their live bait on land or in the trash, and 42.7% (n=35) often or always dried their boats and paddling equipment before launching in other waters. Power washing boats, paddling equipment and trailers had the lowest participation with 45.1% (n=37) never or seldom taking the action. The next action with the lowest participation was disinfecting livewells and bilges with a bleach solution, with 34.1% (n=28) never or seldom taking the action. Respondents that did not own paddling equipment or a boat, or a boat with a livewell, found that some of the actions were not applicable to them, and are represented by N/A in the figure below. These individuals are included in the descriptive summary of actions to prevent the spread of fish diseases shown below (Figure 4.5).

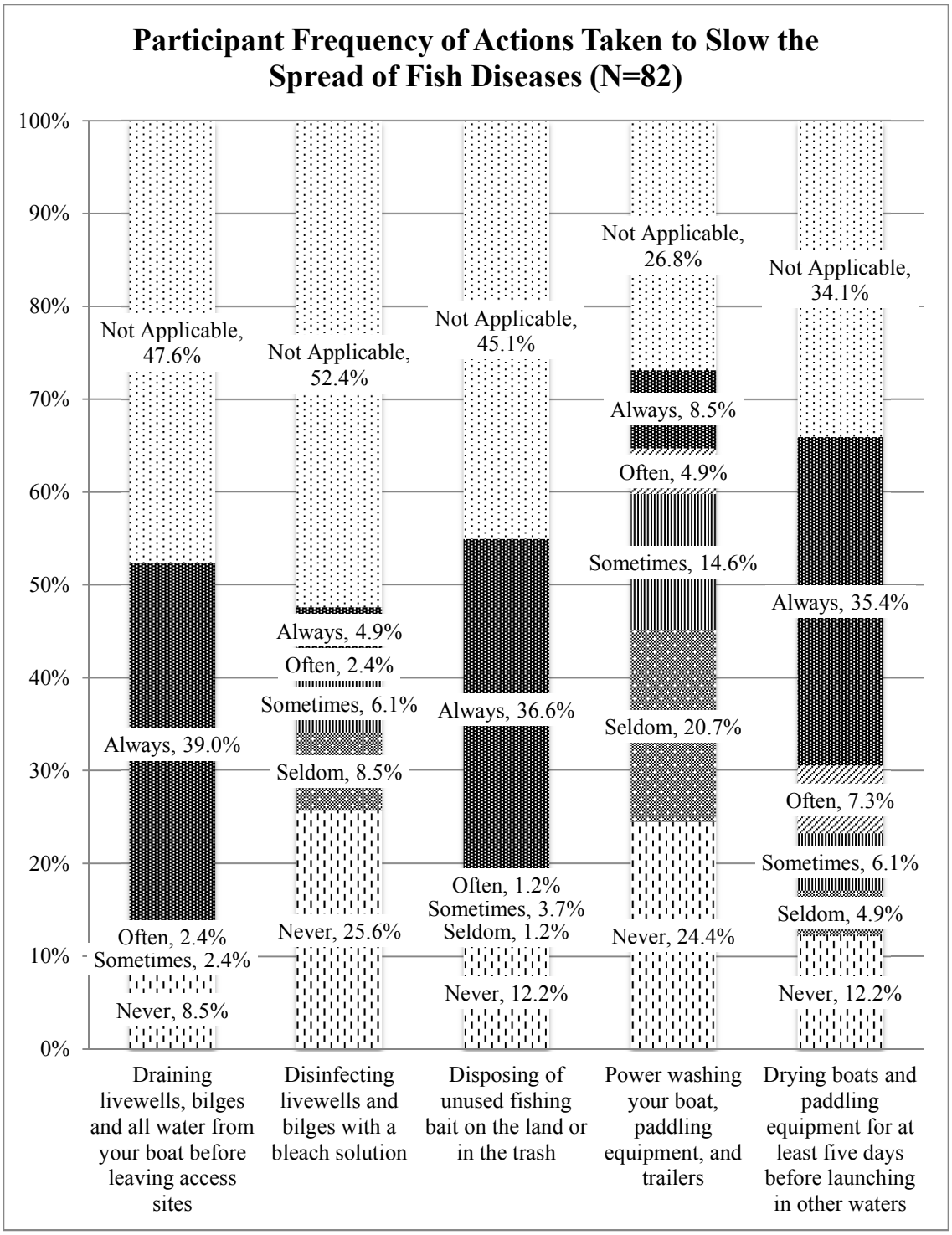


Figure 4.5. Participant frequency of actions taken to slow the spread of fish diseases.

The five messages were evenly distributed to participants– 20.7% (n=17) viewed the gain/disease message, 20.7% (n=17) viewed the loss/disease message, and 19.5%

(n=16) viewed the loss/management, gain/management message, and control message, respectively. A majority of participants either agreed or strongly agreed for each item– intention to seek more information, intention to follow the laws and recommendations to slow the spread of fish diseases, beliefs that fish diseases pose a risk to fisheries and the natural environment respectively, and if they want to learn more about the DNR's fish disease management, and if they trust the communication provided by the DNR Fisheries Division. The summary of these data is shown below (Table 4.4).

Table 4.4. Participant responses to messages shown (N=82)

Response Item	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	No Response
I will seek out more information about how I can reduce the spread of fish diseases.	0.0%	7.3%	15.9%	50.0%	26.8%	0.0%
I intend to follow the laws and recommendations to slow the spread of fish diseases.	0.0%	0.0%	0.0%	50.0%	48.8%	1.2%
I believe fish diseases pose a risk to fisheries.	1.2%	2.4%	1.2%	41.5%	53.7%	0.0%
I believe fish diseases pose a risk to the natural environment.	1.2%	0.0%	2.4%	47.6%	46.3%	2.4%
I want to learn more about DNR Fisheries Division's fish disease management.	1.2%	12.2%	20.7%	52.4%	13.4%	0.0%
I trust this communication provided by the DNR Fisheries Division.	1.2%	1.2%	3.7%	47.6%	45.1%	1.2%

Excluding those participants who chose not to respond, the Likert scale responses

of “Strongly Disagree” to “Strongly agree” were analyzed for each item using a 1 to 5 scale. The means and standard deviations of each interview item are summarized below (Table 4.5). Overall, participant responses were positive. The statement with the highest mean level of agreement was that participants intended to follow the laws and recommendations to slow the spread of fish diseases at 4.494. Participants showed the least agreement to learning more about DNR Fisheries Division’s fish disease management, although the mean level of agreement is still 3.646, which is above a “Neutral” response.

Table 4.5. Mean[1] and standard deviation of level of agreement to statements following exposure to message

	Mean[1]	Standard Deviation	Number of Respondents (n)
I intend to follow the laws and recommendations to slow the spread of fish diseases.	4.494	0.5031	81
I believe fish diseases pose a risk to fisheries.	4.439	0.7552	82
I believe fish diseases pose a risk to the natural environment.	4.413	0.6693	80
I trust this communication provided by the DNR Fisheries Division.	4.358	0.7299	81
I will seek out more information about how I can reduce the spread of fish diseases.	3.963	0.8527	82
I want to learn more about DNR Fisheries Division’s fish disease management.	3.646	0.9077	82

[1]Likert scale responses of “Strongly Disagree” to “Strongly agree” using a 1 to 5 scale.

The Kruskal-Wallis H test results for Hypotheses 1 and 2, show the results for each response variable item, as well as results of Mann-Whitney U tests for other possible effects on the dependent items (Tables 4.6 and 4.7). Mean ranks for each response variable per communication frame shown are also reported (Table 4.8).

Table 4.6. Kruskal Wallis H test results

		I will seek out more information about how I can reduce the spread of fish diseases.		I intend to follow the laws and recommendations to slow the spread of fish diseases.		I believe fish diseases pose a risk to fisheries.		I believe fish diseases pose a risk to the natural environment.		I want to learn more about DNR Fisheries Division's fish disease management.		I trust this communication provided by the DNR Fisheries Division.	
Grouping Variable	d.f.	χ^2 value	p-value	χ^2 value	p-value	χ^2 value	p-value	χ^2 value	p-value	χ^2 value	p-value	χ^2 value	p-value
Communication frame[1]	4	8.391	0.078[2]	9.256	0.055[2]	2.228	0.694	2.428	0.658	6.343	0.175	2.312	0.679
Education	5	1.189	0.946	6.621	0.25	8.063	0.153	5.633	0.344	4.604	0.466	4.978	0.419
Income	6	6.045	0.418	10.415	0.108	9.408	0.152	6.824	0.337	4.242	0.644	3.601	0.73
Event attended	3	5.206	0.157	5.837	0.12	4.587	0.205	4.669	0.198	2.101	0.552	6.008	0.111

[1]Test of Hypothesis 1. There is no significant difference between mean ranks of the five independent messages. We fail to reject the null hypotheses at α=0.05. [2]Significant at level α=0.10.

Table 4.7. Mann-Whitney U test p-value results

	I will seek out more information about how I can reduce the spread of fish diseases.	I intend to follow the laws and recommendations to slow the spread of fish diseases.	I believe fish diseases pose a risk to fisheries.	I believe fish diseases pose a risk to the natural environment.	I want to learn more about DNR Fisheries Division's fish disease management.	I trust this communication provided by the DNR Fisheries Division.
Grouping Variable	p-value	p-value	p-value	p-value	p-value	p-value
Gender (Male/Female)	0.433	0.226	0.214	0.495	0.671	0.057[2]
Fishing from land or shore (Yes/No)	0.055[2]	0.316	0.394	0.388	0.153	0.779
Fishing from boat, canoe, or kayak (Yes/No)	0.012[1]	0.946	0.739	0.49	0.501	0.431

Table 4.7. (cont'd).

Recreational boating (Yes/No)	0.294	0.953	0.707	0.518	0.917	0.557
Personal watercraft (Yes/No)	0.164	0.056	0.17	0.134	0.653	0.591
Recreational paddling (Yes/No)	0.93	0.205	0.323	0.49	0.748	0.811

[1]Significant at level α=0.05. [2]Significant at level α=0.10

Table 4.8. Mean ranks of Kruskal Wallis H tests for response variables by communication frame shown grouping variable

	Gain/Disease	Loss/Disease	Control	Loss/Management	Gain/Management	
Variable	Mean Rank (n)	Mean Rank (n)	Mean Rank (n)	Mean Rank (n)	Mean Rank (n)	Total (N)
Intention to seek more information to reduce the spread of fish diseases	47.65 (n=17)	44.97 (n=17)	43.59 (n=16)	43.09 (n=16)	27.59 (n=16)	82
Intention to follow the laws and recommendations to slow the spread of fish diseases	49.59 (n=17)	43.78 (n=16)	41.25 (n=16)	41.25 (n=16)	28.59 (n=16)	81
Belief that fish diseases pose a risk to the natural environment	43.41 (n=17)	37.53 (n=17)	41 (n=16)	47.13 (n=16)	38.56 (n=16)	82
Belief that fish diseases pose a risk to fisheries	39.91 (n=17)	39.5 (n=15)	39.84 (n=16)	47.06 (n=16)	36.16 (n=16)	80
Want to learn more about MDNR Fisheries Division's fish disease management	50.09 (n=17)	43.41 (n=17)	42.97 (n=16)	38.75 (n=16)	31.63 (n=16)	82
Trust in MDNR communications	43.88 (n=17)	43.56 (n=16)	41.63 (n=16)	34.13 (n=16)	41.63 (n=16)	81

Although not statistically significant at $\alpha=0.05$, communication framing does produce p-values of less than 0.10 in response variables of intentions to seek more information about reducing the spread of fish diseases and intentions to follow the laws and recommendations to slow the spread of fish diseases. The gain frame in a disease context had the highest mean ranks in seeking information about reducing the spread of fish diseases and intentions to follow the laws and recommendations at p-values of less than 0.10, as well as the highest mean ranks for wanting to learn more about MDNR Fisheries Division's fish disease management, and trust in MDNR communications in general– with 47.65, 49.59, 50.09, and 43.88 respectively. The gain frame in the disease management context had the lowest mean ranks in in seeking information about reducing the spread of fish diseases, intentions to follow the laws and recommendations, wanting to learn more about MDNR Fisheries Division's fish disease management, with 27.59, 28.59, and 31.63 respectively.

For beliefs that fish diseases pose a risk to the natural environment and to fisheries, the loss frame in the disease management context had the highest mean ranks of 47.13 and 47.16 respectively. Also, the control message yielded the median mean rank for each response variable.

Below is a summarization of the Mann-Whitney U test for the mean ranks of intentions to seek more information to reduce the spread of fish diseases for the grouping variables of fishing from a boat, canoe, or kayak and fishing from land or shore (Table 4.9). Participants who did not fish from a boat, canoe, or kayak (n=22) had a mean rank of 31.29 and those who did fish using a boat, canoe, or kayak (n=60) had a mean rank of

45.21. This is a significant difference between the two groups (p=0.012 at α=0.05). Also, fishing from land or shore produces a p-value of less than 0.10 (p=0.055 α=0.05) for seeking more information about reducing the spread of fish diseases. The mean rank for participants that fish from land or shore (n=64) is 43.97 and for those that do not (n=18) is 32.72.

Table 4.9. Mean rank differences for the fishing from a boat, canoe or kayak and fishing from land or shore grouping variables

Intention to seek more information to reduce the spread of fish diseases	Fishing from boat, canoe, or kayak	N	Mean Rank
	No	22	31.39
	Yes	60	45.21
	Fishing from land or shore	N	Mean Rank
	No	18	32.72
	Yes	64	43.97

Participating in the activity of personal watercraft (e.g. jet skiing) also provides a p-value of less than 0.10 (0.056 at α=0.05) in the intention to follow the laws and recommendations to slow the spread of fish diseases. The mean ranks of the two independent groups are shown below (Table 4.10). Those who do participate have a mean rank of 51.38, while those that do not have a mean rank of 39.2.

Table 4.10. Mean rank differences for intentions to follow laws and recommendations by personal watercraft grouping variable

	Personal Watercraft	N	Mean Rank
Intention to follow the laws and recommendations to slow the spread of fish diseases	No	69	39.2
	Yes	12	51.38

In addition, there is a gender difference in trust of communication provided by the DNR Fisheries Division (p=0.057 at α=0.05). Mann-Whitney U test results (Table 4.11)

yield a mean rank of 36.41 for males (n=39) and 45.26 for females (n=42).

Table 4.11. Mean rank of trust in MDNR communications by gender grouping variable

	Gender	N	Mean Rank
Trust in MDNR communications	Male	39	36.41
	Female	42	45.26
	Total	81	

Also, the event attended grouping variable produces a p-value close to 0.10 ($p=0.111$ at $\alpha=0.05$) for trust in communication (Table 4.12). The highest mean rank for the events in the trust variable was the Women's Expo in Grand Rapids, MI, with 49.32. The mean ranks for intentions to follow the laws and recommendations to slow the spread of fish diseases had a wider disparity, with the Boat Show in Grand Rapids, MI having a mean rank of 33.33 and the Ultimate Sports Show in Grand Rapids having the highest rank at 51.38.

Table 4.12. Mean ranks of trust in MDNR communications and intentions to follow laws and recommendations for event grouping variable

	Event	N	Mean Rank
Trust in MDNR communications	Women's Expo in GR	25	49.32
	Outdoorama in Novi	25	38.84
	Boat Show in GR	23	36.57
	Ultimate Sports Show in GR	8	34.5
	Total	81	
Intention to follow the laws and recommendations to slow the spread of fish diseases to slow the spread of fish diseases	Ultimate Sports Show in GR	8	51.38
	Women's Expo in GR	25	43.68
	Outdoorama in Novi	25	42.06
	Boat Show in GR	23	33.33
	Total	81	

Discussion

In this particular testing of communication framing pertaining to risks to the natural environment in the context of fish disease and fish disease management, gain and

loss framing had no significant effect on participants' intention of seeking more information, their intention to follow the laws and recommendations to slow the spread of fish diseases, their beliefs that fish diseases pose a risk to fisheries and the natural environment, if they want to learn more about the MDNR's fish disease management, and if they trust the communication provided by the MDNR Fisheries Division. In addition, gain framing is not significantly more effective than loss framing, so I fail to reject the null hypotheses, Hypotheses 1 a, b, and c, at level $\alpha=0.05$.

Communication framing does approach and come close to significance at the level of $\alpha=0.05$ for intentions of seeking more information and intentions to follow the laws and recommendations. In these intentions, the gain frame in a disease context was most effective. This means that by communicating the positive things that will happen if people take certain actions, participants were more likely to intend to seek more information about how they can reduce the spread of fish disease and intend to follow the laws and recommendations to slow the spread of fish diseases.

Although not significant at level $\alpha=0.05$, a loss frame in a management context is most effective for increasing risk perceptions, or the beliefs that fish diseases pose a risk to the natural environment and to fisheries. This is shown by this particular frame yielding the highest mean rank over the other framed and control messages. These results suggest that if an agency would like to increase stakeholder risk perceptions of a certain disease, they should develop a loss frame within the context of disease management.

Other analysis results indicate that demographic variables such as education, and income have no significant influence on participant responses to the same items. Gender does become significant at the $\alpha=0.10$ level, with females having a higher mean rank,

meaning they are more trusting, than males of DNR Fisheries Division communications. The Women's Expo in Grand Rapids also had the highest mean rank in trust in MDNR communications out of all of the events and where I interviewed the largest proportion of females. This difference in trust may be because females tend to hold different opinions and views in many other natural resource issues like hunting, preferences for participating in wildlife related citizen participation processes, environmental values, concern about specific, local, anthropogenic environmental risks, and actions they are willing to take to respond to risks than their male counterparts (Anthony, Knuth, & Bruce Lauber, 2004; Zinn & Pierce, 2002). Also, within this study, there were more women who did not participate in a fishing activity than men. With some women having less fishing knowledge or experience, they may just inherently trust communications by the MDNR Fisheries Division, compared to men who may have had experiences interacting with MDNR employees, MDNR actions like fish stocking, or conservation officers.

In investigating if participation in various aquatic-based recreational activities affected these same item responses, only fishing from a boat, canoe, or kayak yielded a significant result at level $\alpha=0.05$ for the item of seeking more information on how participants could reduce the spread of fish diseases. Participants who did not fish from a boat canoe, or kayak had a lower mean rank than those who did fish using those methods As higher levels of agreement to the items correlated with higher values (4 and 5 for agree and strongly agree respectively), this means that there was a greater disparity in intentions to seek more information– with fishermen who used a boat, canoe, or kayak for the activity intending to seek more information, while those who did not fish from a boat, canoe, or kayak, having lesser intentions to seek information. This may be because those

who use a boat or paddling equipment for fishing are likely to see more fishing-related, and possibly disease-related information, at boating access points or docks than those who may just walk to a secluded river bank or unmarked pier to fish. Boaters may also perceive that they have a larger role in the spread, as they have more equipment and means of potentially transporting fish diseases from lake to lake. This may prompt them to seek more information in what they can do to reduce the spread of fish disease.

Participating in personal watercraft activities, like jet skiing, also yields a p-value of less than 0.10 in the intention to follow the laws and recommendations to slow the spread of fish diseases. Those who do participate in the activity have a have a higher mean rank. This may be because jet skis are easily and highly portable and used on many lakes, and those who do participate may feel a need to follow the laws and recommendations to slow the spread of fish diseases. Also, of those who do participate in the activity, a majority of them also participate in fishing activities, so that may motivate them to follow laws and recommendations to help keep fisheries healthy.

The mean ranks for intentions to follow the laws and recommendations to slow the spread of fish diseases had a wider disparity, with participants from the Boat Show in Grand Rapids, MI having the lowest mean rank and participants from the Ultimate Sports Show in Grand Rapids, MI having the highest rank. From my conversations with participants, there were many recreational boaters that kept their boats in one body of water throughout the season. As the Boat Show in Grand Rapids, MI had many recreational boats on display and attracted recreational boaters, maybe the attendees there felt that they weren't contributing as much to the spread of fish disease as fishermen who may be moving between bodies of water more frequently.

In regards to the actions to reduce the spread of fish disease items, many participants found that they were not applicable, as they did not own a boat, a boat with a livewell or bilge, or paddling equipment, and/or were not the ones taking directly taking actions. This is dissimilar from Lee et al. (2015), as their sample consisted of only registered boat owners.

There was complete agreement among participants to intending to follow laws and recommendations to slow the spread of fish diseases. A conservation officer (CO) was present most of the time at the outreach booths, possibly biasing participant responses to this interview item. This was addressed by letting participants know that the interviewers affiliation was with a university, not the DNR. In addition, the content of the DNR outreach booths as well as employees staffing the booths may have biased responses. “Help Stop Aquatic Hitchhikers” and “Help Michigan’s waters stay world class, put unused bait in the trash” displays were used at three of the four data collection events.

Although the analysis yielded no significant results at level $\alpha=0.05$ for gain and loss framing in the context of fish disease and fish disease management regarding risk to the natural environment, there were still results that should be noted at the $\alpha=0.10$ level, as well as certain frames consistently yielded the highest mean ranks for certain categories of response variables. An overview of what types of frames were more effective for each category of response variable– behavioral intentions, risk perceptions, or trust– is shown below (Table 4.13). This could be used as a general guideline when creating new framed communications about fish diseases in Michigan.

Table 4.13. Guidelines for framing fish disease communications for desired responses

Positive Response Desired	Type of Frame Suggested for Use

Table 4.13. (cont'd).

Behavioral intentions- Seeking more information and following the laws and recommendations	Gain frame Disease context
Risk perceptions- Beliefs fish diseases pose a risk to the natural environment and fisheries	Loss frame Disease management context
Trust in MDNR communications	Gain frame Disease context

The insights learned from this study also suggest that the current MDNR messaging "Help Michigan's waters stay world class, put unused bait in the trash," a gain frame in a disease context, is likely an effective message for positive behavioral intentions regarding fish disease and trust in MDNR communications, but should be tested for confirmation. This finding is also consistent with the literature that gain framing can be slightly more effective at times (O'Keefe & Jensen, 2007; Spence & Pidgeon, 2010). Although not statistically significant, if the agency wanted to increase risk perceptions of fish disease, the results of this study suggest that the MDNR Fisheries Division should be using a loss frame in a disease management context.

Results from this study show that framing in terms of gains or losses should certainly be considered in communication about fish diseases, dependent upon the desired outcomes of the natural resource agency, for example increased behavioral intentions– to both seeking information and following laws and regulations– as well as increased perceived risks. In addition, this community-engaged research provides communication practitioners with insights to their audience. The significant result based upon participation in aquatic-based recreational activities provides evidence that communicators should be aware and make sure that their audience characteristics and the desired actions or results they are communicating about are in agreement.

Limitations and Future Research

This research included a relatively small, convenience sample size, and results should not be generalized to other states. Other data collection methods that allow for larger sample sizes should be employed to better generalize results. Also, as the data was collected at DNR outreach booths– people that were interviewed already had the propensity to interact with DNR, and future research could be conducted at other events and not in conjunction with a natural resource agency. "Fish diseases" was used as a term in general within the framed messages in the hopes to apply insights of the research to a broader disease context– asking questions pertaining to a specific disease may yield different results. This study also focused on risks to the natural environment from fish disease, and other risks, such as risks to fishing or the culture of fishing could also be tested using gain and loss framing. This may provide better insight for what type of frame agencies should use for certain risks. In future research, the current messaging used by the agency should be included in testing, for comparison to newly developed framed messaging. Also, as the context of aquatic disease was used for gain and loss framing and it has been shown in previous studies that the efficacy for this type of framing is context specific, it is not recommended that results be generalized to terrestrial wildlife diseases and other environmental risks.

Future research could expand the understanding and efficacy of risk communication pertaining to fish diseases. This research only used text and still image-based messages– a study by Perrin (2011) found that video messages were more effective in increasing intent to behave in an environmentally responsible way than text-only messages (Perrin, 2011). Video or audio messages could be used for future testing of gain

and loss framing (Lu, 2016). Also, this research only investigated the relationship between gain and loss framing of fish diseases and certain participant responses like intentions to follow laws and recommendations or seek more information. Future research should also include other techniques for risk communication to compare and contrast their efficacy of communicating risks of fish diseases to stakeholders to achieve other desired responses by natural resource agencies, e.g. increased disease reporting.

CHAPTER 5

IMPLICATIONS

1. This research provides insight into perceptions of risk involving fish diseases in Michigan. Data were collected with people in the field– those actually attending outdoor events and participating in aquatic-based recreational activities. They are the recreationists that have the potential to advance the spread or minimize the spread of fish diseases around the state. Knowledge of stakeholders' risk perceptions and levels of concern about fish disease in the Great Lakes and inland waters of Michigan from these stakeholders can help natural resource agencies prioritize information and education to their stakeholders in the context of aquatic disease, as well as address their concerns using various outreach methods. Since a majority of participants did not know about VHS, it is possible that this information about stakeholder risk perceptions can help practitioners communicate broadly about fish diseases in the future. Agencies are more likely to increase awareness about aquatic-based fish diseases and their management when they address salient topics of stakeholders, such as risks to the overall natural environment, fish populations, and recreational fishing, as well as the risk of contracting the disease from fish consumption. Knowing what aquatic-based recreational users instinctively care about with little to no knowledge about the disease can help define the content of risk communications for the MDNR Fisheries Division, as perceived risks of other fish diseases could be similar to those held for VHS.

2. This research contributes to the expansion and testing of the ZDRISP model, as it has not been used, to my knowledge, in an aquatic context. Adding trust as a variable that influences risk perceptions held by stakeholders expanded this model. Previous studies have found that people who trust the managing agency tend to perceive less risk compared to those who do not (Vaske et al., 2004). Social trust is the willingness of a person to trust those who are charged with making decisions and taking actions related to the management of the environment, medicine, technology, and other public health and safety issues (Siegrist et al., 2000; Vaske et al., 2004). This type of trust can be most influential when individual knowledge about the risk is lacking (Siegrist & Cvetkovich, 2000). Therefore, I introduced agency trust as an attribute that influences perceived hazard characteristics. The expanded ZDRISP model was tested in an aquatic context using VHS as a case study. This sets the stage for further research to test the model in this context and can contribute to knowledge about how to best communicate these types of aquatic disease risk, which may be invisible to most stakeholders, even if the disease of concern is not zoonotic.
3. This research provided insight into the measurement of social trust, as it shows that five items are not necessary to capture a majority of the variance within the trust variable. From analyzing the trust scale, 82.7% of the variance within the scale was composed of two items– the MDNR provided enough information and the MDNR provided the best information. These two items alone could be used to measure trust in future studies.
4. This research provides evidence that trust does not significantly differ between

VHS management areas. As VHS management areas are no longer used for regulations of the disease beginning in 2016, it is a positive finding for managers and means that more effort does not need to be put into certain areas for trust building activities regarding fish disease management of the MDNR Fisheries Division.

5. Many participants had not heard of VHS, while they had heard of other invasive species, such as Asian carp. Future aquatic invasive species messaging by natural resource agencies could include more emphasis on pathogens, especially if there are certain diseases that pose a greater risk to entering the Great Lakes at that time. As hearing of VHS is significant in the concern of VHS to fishing and VHS management to the natural environment, including pathogens on aquatic invasive species signage at aquatic recreation access locations is recommended.
6. This research can inform agencies, such as the DNR Fisheries Division or DEQ, and other natural resource agencies, how they can best frame risks of fish diseases and their management to their stakeholders. Gain and loss framing can be used in future communication efforts– aquatic diseases can be gain framed by describing positive outcomes that will happen or negative outcomes that will not happen, or loss framed by describing the negative outcomes that will happen or the positive outcomes that will not happen (Rothman et al., 2006). A gain frame in a disease context results in the most positive stakeholder response if an agency aims to have their audiences intend to seek more information about fish disease and follow the laws and recommendations associated with it, as well as trust the communication provided by the MDNR. However, a loss frame in a disease management context

yields the highest agreement and should be used if the agency desired their audiences to believe that fish disease is a risk to fisheries and the natural environment, a loss frame in a disease management context yields the highest agreement. As framing effects were occasionally significant at level $\alpha=0.10$, consideration of gain and loss framing is important, especially in new and untested agency-desired stakeholder responses.

7. The insights learned from this study also suggest that the current MDNR messaging "Help Michigan's waters stay world class, put unused bait in the trash," a gain frame in a disease context, is likely an effective message for positive behavioral intentions regarding fish disease and trust in MDNR communications, but should be tested for confirmation. This finding is also consistent with the literature that gain framing can be slightly more effective at times (O'Keefe & Jensen, 2007; Spence & Pidgeon, 2010). Although not statistically significant, if the agency wanted to increase risk perceptions of fish disease, the results of this study suggest that the MDNR Fisheries Division should be using a loss frame in a disease management context.
8. This research provides baseline information to risk communicators in Michigan– especially for audience segmentation. Knowing the proportion of people who fish, recreationally paddle, or use personal watercraft, as well as their sociodemographic characteristics can help them to better target communications about fish disease. These characteristics may influence what risk perceptions are held and the type of communication frame, gain or loss, will be most effective. For example, when testing gain and loss framed messages, gender became

significant at the $\alpha=0.10$ level, with females having a higher mean rank, meaning they are more trusting, than males of DNR Fisheries Division communications. The Women's Expo in Grand Rapids also had the highest mean rank in trust in MDNR communications out of all of the events and where I interviewed the largest proportion of females. This difference in trust may be because females tend to hold different opinions and views in many other natural resource issues like hunting, preferences for participating in wildlife related citizen participation processes, environmental values, concern about specific, local, anthropogenic environmental risks, and actions they are willing to take to respond to risks than their male counterparts (Anthony et al., 2004; Zinn & Pierce, 2002). Also, within this study, there were more women who did not participate in a fishing activity than men. With some women having less fishing knowledge or experience, they may inherently trust communications by the MDNR Fisheries Division, compared to men who may have had experiences interacting with MDNR employees, MDNR actions like fish stocking, or conservation officers.

9. Participants provided suggestions for enhancing invasive species outreach; one recommendation was for boat washing stations to be made available near Michigan waterways and access points. The action of never washing a boat between bodies of water decreased in Michigan boaters from 2004 to 2012, but currently, there are few boat washing stations at access locations throughout the state (Lee et al., 2015). Even though boat washing is a recommended action, some participants said they would use such a station if it existed at their boat launch. People may need to be provided the means to carry out agency-desired actions.

APPENDICES

APPENDIX A – Interview Schedule

Table 6.1. Interview schedule

	Thursday	Friday	Saturday	Sunday
	July 9th	**July 10th**	**July 11th**	**July 12th**
Morning	Brimley	Curtis	Hessel	Raber
Evening	Paradise	Naubinway	St. Ignace	SSM
	July 16th	**July 17th***	**July 18th**	**July 19th**
Morning	SSM	St. Ignace	Naubinway	Paradise
Evening	Raber	Hessel	Curtis	Brimley
	August 6th	**August 7th****	**August 8th**	**August 9th**
Morning	Naubinway	Paradise	SSM	St. Ignace
Evening	Curtis	Brimley	Raber	Hessel
	August 13th	**August 14th**	**August 15th**	**August 16th**
Morning	Hessel	Raber	Brimley	Curtis
Evening	St. Ignace	SSM	Paradise	Naubinway

*Wednesday, July 15th was used for alternate interviewing at St. Ignace and Hessel access sites as weather forecasted inclement weather.

**Wednesday, August 12, 2015 from 4pm-8pm was used for alternate interviewing at the Brimley access site as it experienced inclement weather.

APPENDIX B – Part A Interview Guide

Interview Guide

Hello, my name is [insert name]; I am a [insert position] at Michigan State University conducting a study of risk perceptions of fish disease in the Eastern Upper Peninsula. This research is supported by Michigan State University, MSU Extension, and Michigan Sea Grant. I was wondering if you would be willing to take about 20 minutes of your time and chat with me about your thoughts.

The purpose of this interview is to learn more about your attitudes and perceptions in regards to fish diseases, more specifically, a fish disease called Viral Hemorrhagic Septicemia, or VHS, in Michigan waters and the Great Lakes. Your participation will be very valuable, as the results will help to inform state and local fisheries managers in developing educational outreach materials based on interests and concerns of aquatic-based recreational users such as yourself. Even if you don't feel you know much about VHS in Michigan and the Great Lakes region, your responses are still important to incorporate so I would like you to consider participating in this study.

I'm hoping to digitally record our interview, but if you'd like I can take handwritten notes instead. Your name will not be connected to any of your responses and the interview materials will be stored in a locked cabinet on MSU campus. This interview is voluntary and you can change your mind about participating at any time. At the end of the interview, you may choose to provide your contact information on a separate card to be entered into a drawing for one of five $50 Walmart gift cards, which if you are selected, will be mailed to you after the drawing is held in late August. By agreeing to proceed with this interview, you are consenting to participate in the study.

Are you age 18 years or older? Check one: ☐Yes ☐No Interviewer Initials: _____

May we proceed with the interview?

Oral consent given for participation. Check one: ☐Yes ☐No Interviewer Initials: _____

May I digitally record it?

Oral consent given for digital recording. Check one: ☐Yes ☐No Interviewer Initials: _____

Interviewer:	
Date:	
Day of Week:	
Time:	

Check boxes that correspond to location of interview:

A. County	B. Access Point	C. VHS Management Area
☐ Chippewa	☐ Bay Mills Ramp, **Brimley** (F) ☐ Tahq. Falls Access, **Paradise (**F) ☐ Raber Bay Ramp, **Raber** (S) ☐ Aune Osborn, **Sault Ste. Marie** (S)	☐ Positive (P) ☐ Surveillance (S) ☐ Free (F)
☐ Mackinac	☐ Curtis Ramp, **Curtis** (F) ☐ Hessel Marina, **Hessel** (P) ☐ Naubinway Marina, **Naubinway** (S) ☐ St. Ignace Ramp, **St. Ignace** (P)	

I'd like to start with some basic questions related to aquatic-based recreational activities you may participate in:

1. Do you participate in any of the following aquatic-based recreational activities on Michigan inland lakes and streams or on the Great Lakes? Please answer yes or no.	Yes	No
a) Fishing from land or shore	☐	☐
b) Fishing from any type of boat, canoe, or kayak	☐	☐
c) Recreational boating, for example, a motorboat, sail boat, or row boat	☐	☐
d) Personal watercraft, for example, a jet ski	☐	☐
e) Recreational paddling, for example, a canoe, kayak, or paddleboard	☐	☐
f) If there are any others, please describe them:		

2. Are you a member of any associations, organizations, or clubs related to these activities, for example, a fishing club, boating organization, or paddling club?

____No

____Yes →Could you please list the names of the associations, organizations, or clubs you are a member of?

_____

_____

Next, I would to talk about a specific fish disease, Viral Hemorrhagic Septicemia, or VHS, and ask about your concerns and perceptions about risks from the disease itself, meaning risks directly from Viral Hemorrhagic Septicemia or VHS.

3. When you think of VHS, what do you believe it poses a threat to?

_____

_____

_____

a) What about risks to your health?

_____

_____

_____

b) What about risks to the natural environment?

_____

_____

_____

c) What about risks to your economic livelihood?

_____

_____

_____

d) What about risks to fishing in Michigan?

_____
_____
_____

e) What about risks to the culture of fishing in Michigan?

_____
_____
_____

4. What is your top concern about risks from VHS?

____ To my health
____ To the natural environment
____ To my economic livelihood
____ To fishing in Michigan
____ To the culture of fishing in Michigan

Now, I'm going to ask you about your concerns and perceptions about the risks from the management of VHS. Management of VHS is defined for this study as the policies, regulations and best management practices of the Michigan Department of Natural Resources Fisheries Division to slow the transmission of VHS to other bodies of water.

5. Are you familiar with the policies, regulations, and best management practices to slow the transmission of VHS to other bodies of water? What do you know about them?

_____
_____
_____
_____

6. When you think of the management of VHS, what do you believe it poses a threat to?

_____
_____
_____

a) What about risks to your health?

_____
_____
_____

b) What about risks to the natural environment?

_____
_____
_____

c) What about risks to your economic livelihood?

_____
_____
_____

d) What about risks to fishing in Michigan?

_____
_____
_____

e) What about risks to the culture of fishing in Michigan?

_____

_____
_____

7. What is your top concern about risks from VHS management?

____ To my health
____ To the natural environment
____ To my economic livelihood
____ To fishing in Michigan
____ To the culture of fishing in Michigan

Next I am going to ask questions regarding your trust in the Michigan Department of Natural Resources Fisheries Division.

8. Could you elaborate on your trust in the Michigan Department of Natural Resources Fisheries Division? What do you believe influences your level of trust?

_____
_____
_____

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
9. The Michigan Department of Natural Resources Fisheries Division…						
a) Provided enough information to make decisions about taking action to slow the spread of VHS and other fish diseases	☐	☐	☐	☐	☐	☐
b) Can be trusted to provide the best available information about VHS	☐	☐	☐	☐	☐	☐
c) Information about VHS is believable	☐	☐	☐	☐	☐	☐
d) Can be trusted to make good management decisions regarding VHS	☐	☐	☐	☐	☐	☐
e) Provided lots of opportunities to listen to individuals' concerns about VHS	☐	☐	☐	☐	☐	☐

10. Could you please elaborate more on your trust in the MDNR Fisheries Division's fish disease management? What influences your trust in the MDNR Fisheries Division in this context of fish disease management?

_____
_____
_____

11. How concerned are you about having fish diseases in the Great Lakes?

____Very concerned
____Moderately concerned
____Slightly concerned
____Not at all concerned
____Never thought about it before this interview

12. How concerned are you about having fish diseases in Michigan's inland lakes?
____Very concerned
____Moderately concerned
____Slightly concerned
____Not at all concerned
____Never thought about it before this interview

13. Before this interview, had you ever heard of the fish disease called Viral Hemorrhagic Septicemia or VHS?
____No
____Yes, recognize the name but don't know much about it
____Yes, recognize the name and know something about it
→(If yes) How did you learn about it?

_____
_____

14. Is there anything else related to risks from VHS or fish diseases you would like to share with me that you think I missed?

_____
_____
_____

Now, I'm going to ask you some wrap-up questions to conclude this interview….

15. Are you, (Check Male or Female)
____Male
____Female
____Prefer not to answer

16. What is the year you were born?
_____

17. What is the highest level of education you have completed?
____Less than high school
____High school diploma or G.E.D.
____Some college or technical school
____Associate's degree
____College undergraduate degree (e.g., B.A., B.S.)
____Graduate or professional degree (e.g., M.S., Ph.D., M.D., J.D.)

18. What was your household income, before taxes, in 2014?
____$40,000 or less
____$40,000-$60,000
____$60,000-$80,000
____$80,000-$100,000

____$100,000-$120,000
____$120,000 or more
____ Prefer not to answer

19. What is your city and state of residence?

_____

20. Before we end the interview, is there anything else you would like to share with me?

_____
_____
_____

Thank you very much for your time. I greatly appreciate your participation. If you would like to be entered into the drawing for one of five $50 Walmart gift cards, please write your contact information on this separate card, and if you would like to receive the results of this study, please check the box next to, "I would like to receive results of this study." (Provide contact card)

Also, if you have any other questions about this study later, please feel free to use this contact information to ask. (Provide ½ sheet with project description, all contact info, IRB #, etc.)

If you're interested in learning more about VHS, I also have handouts that you might like to have. (Provide handouts)

Time of interview completion	

Other Interview Notes:

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
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_____
_____
_____

Figure 6.1. Gain frame in a disease context.

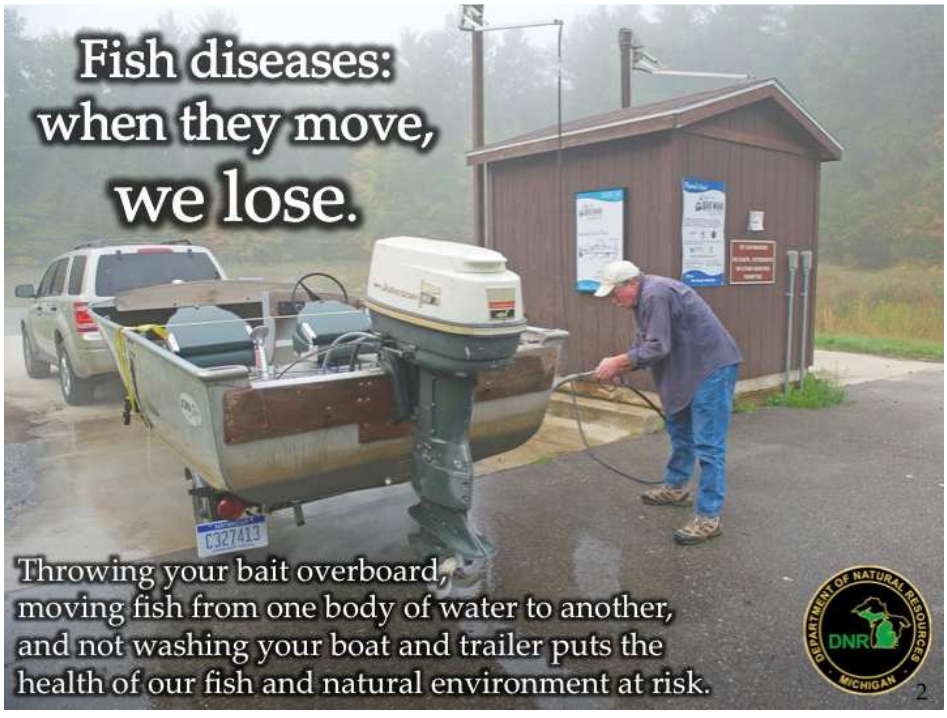

Figure 6.2. Loss frame in a disease context.

Figure 6.3. Gain frame in a disease management context.

Figure 6.4. Loss frame in a disease management context.

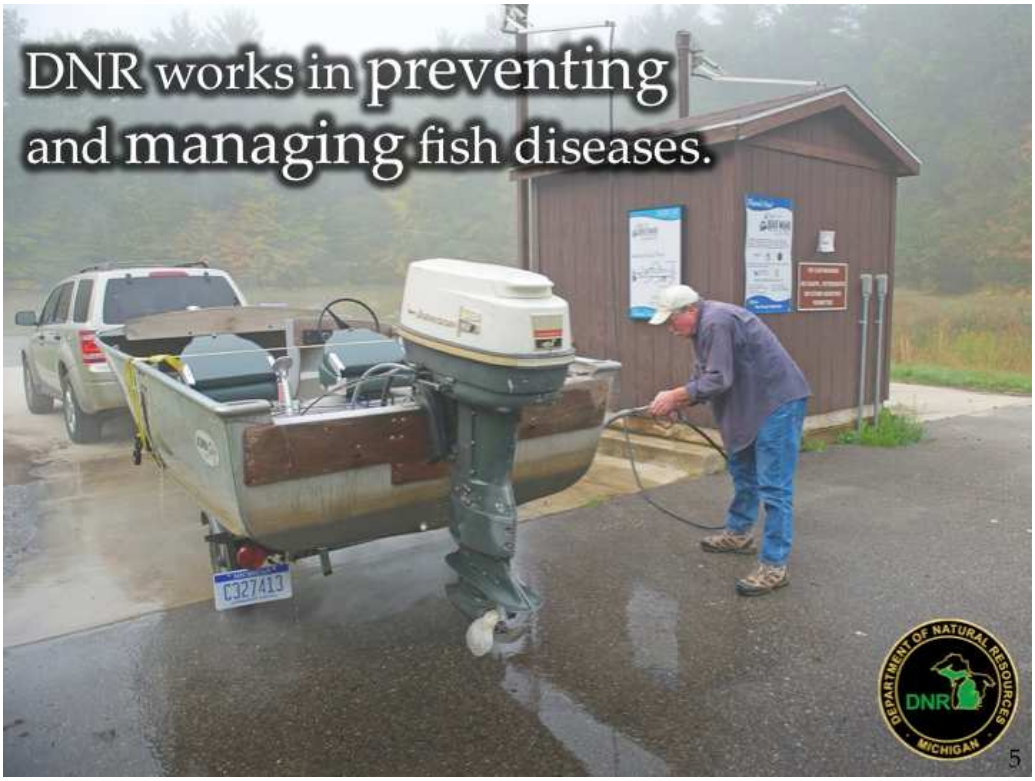

Figure 6.5. Control message that is neither gain or loss frame.

APPENDIX D – Part B Interview Guide For Gain/Loss Framing

MICHIGAN STAKEHOLDERS' PERCEPTIONS OF RISK FROM FISH DISEASE (VHS) AND TRUST IN AGENCY MANAGERS: MESSAGE TESTING USING GAIN AND LOSS FRAMING

Hello, my name is Erin Jarvie; I am a graduate student at Michigan State University conducting a study of risk communication and a fish disease called viral hemorrhagic septicemia (VHS). This research is supported by Michigan State University, MSU Extension, Michigan Sea Grant, and the Michigan Department of Natural Resources. I was wondering if you would be willing to take less than 10 minutes of your time to participate in the study. I will ask some preliminary questions and show you a risk communication image, followed by a few more questions.

The purpose of this survey is to learn more about your attitudes and reactions in regards to communication materials about fish diseases in Michigan waters and the Great Lakes. Your participation will be very valuable, as the results will help to inform state fisheries managers in developing future educational outreach materials based on the feedback of aquatic-based recreational users such as yourself.

At the end of the interview, you may choose to provide your contact information on a separate card to be entered into a drawing for one of five $20 Meijer gift cards, which if you are selected, will be mailed to you after the drawing is held in early April. This survey is voluntary and you can change your mind about participating at any time. By agreeing to proceed with the survey, you are consenting to participate in the study.

Are you age 18 years or older? Check one: ☐Yes ☐No Interviewer Initials: _____

May we proceed with the survey?

Oral consent given for participation. Check one: ☐Yes ☐No Interviewer Initials: _____

Interviewer:	
Date:	
Location/Event:	
Time:	
Message Shown (#):	

1. Do you participate in any of the following aquatic-based recreational activities on Michigan inland lakes and streams or on the Great Lakes? Please answer yes or no.	Yes	No
a) Fishing from land or shore	☐	☐
b) Fishing from any type of boat, canoe, or kayak	☐	☐
c) Recreational boating, for example, a motorboat, sailboat, or rowboat	☐	☐
d) Personal watercraft, for example, a jet ski	☐	☐
e) Recreational paddling, for example, a canoe, kayak, or paddleboard	☐	☐

Please indicate your level of agreement to the following statement.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
2. I am aware of the laws and recommendations that are in place to protect against fish diseases in Michigan.	☐	☐	☐	☐	☐

3. How often you currently take the following actions?	Never	Seldom	Sometimes	Often	Always	N/A
a) Draining livewells, bilges and all water from your boat before leaving access sites?	☐	☐	☐	☐	☐	☐
b) Disinfecting livewells and bilges with a bleach solution?	☐	☐	☐	☐	☐	☐
c) Disposing of unused fishing bait on the land or in the trash?	☐	☐	☐	☐	☐	☐
d) Power washing your boat, paddling equipment, and trailers?	☐	☐	☐	☐	☐	☐
e) Drying boats and paddling equipment for at least five days before launching in other waters?	☐	☐	☐	☐	☐	☐

Based upon this image and message shown, please indicate your level of agreement to the following statements:	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
4) I will seek out more information about how I can reduce the spread of fish diseases.	☐	☐	☐	☐	☐
5) I intend to follow the laws and recommendations to slow the spread of fish diseases.	☐	☐	☐	☐	☐
6) I believe fish diseases pose a risk to fisheries.	☐	☐	☐	☐	☐
7) I believe fish diseases pose a risk to the natural environment.	☐	☐	☐	☐	☐
8) I want to learn more about DNR Fisheries Division's fish disease management.	☐	☐	☐	☐	☐
9) I trust this communication provided by the DNR Fisheries Division.	☐	☐	☐	☐	☐

Now I have some demographic questions to complete the survey.

10. Are you male or female?
    ____Male ____Female
11. What is the year you were born?
    _____
12. What is the highest level of education you have completed?
    ____Less than high school
    ____High school diploma or G.E.D.
    ____Some college or technical school
    ____Associate's degree
    ____College undergraduate degree (e.g., B.A., B.S.)
    ____Graduate or professional degree (e.g., M.S., Ph.D., M.D., J.D.)
13. What was your household income, before taxes, in 2015?
    ____$40,000 or less
    ____$40,000-$60,000
    ____$60,000-$80,000
    ____$80,000-$100,000
    ____$100,000-$120,000

____$120,000 or more
____ Prefer not to answer

14. What is your city and state of residence?

_____

APPENDIX E – MSU IRB Approval Letter

MICHIGAN STATE
UNIVERSITY

Initial IRB Application Determination *Exempt*

June 12, 2015

To: Heather Triezenberg
305 Manly Miles Building
1405 S. Harrison Road
East Lansing, MI 48823-5243

Re: **IRB# x15-651e** Category: Exempt 2
Approval Date: June 12, 2015

Title: MICHIGAN STAKEHOLDERS' PERCEPTIONS OF RISK FROM FISH DISEASE (VHS) AND TRUST IN AGENCY MANAGERS: ASSESSMENT USING THE ZOONOTIC DISEASE RISK INFORMATION SEEKING AND PROCESSING (ZDRISP) MODEL AND MESSAGE TESTING USING GAIN AND LOSS FRAMING

The Institutional Review Board has completed their review of your project. I am pleased to advise you that **your project has been deemed as exempt** in accordance with federal regulations.

The IRB has found that your research project meets the criteria for exempt status and the criteria for the protection of human subjects in exempt research. **Under our exempt policy the Principal Investigator assumes the responsibilities for the protection of human subjects** in this project as outlined in the assurance letter and exempt educational material. The IRB office has received your signed assurance for exempt research. A copy of this signed agreement is appended for your information and records.

Renewals: Exempt protocols do not need to be renewed. If the project is completed, please submit an ***Application for Permanent Closure***.

Revisions: Exempt protocols do not require revisions. However, if changes are made to a protocol that may no longer meet the exempt criteria, a new initial application will be required.

Problems: If issues should arise during the conduct of the research, such as unanticipated problems, adverse events, or any problem that may increase the risk to the human subjects and change the category of review, notify the IRB office promptly. Any complaints from participants regarding the risk and benefits of the project must be reported to the IRB.

Follow-up: If your exempt project is not completed and closed after three years, the IRB office will contact you regarding the status of the project and to verify that no changes have occurred that may affect exempt status.

Please use the IRB number listed above on any forms submitted which relate to this project, or on any correspondence with the IRB office.

Good luck in your research. If we can be of further assistance, please contact us at 517-355-2180 or via email at IRB@msu.edu. Thank you for your cooperation.

Sincerely,

H. McGee

Harry McGee, MPH
SIRB Chair

c: Erin Jarvie, Bruno Takahashi, William Taylor

Office of Regulatory Affairs
Human Research Protection Programs

Biomedical & Health Institutional Review Board (BIRB)

Community Research Institutional Review Board (CRIRB)

Social Science Behavioral/Education Institutional Review Board (SIRB)

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IRB Update on February 18, 2016

Greetings Investigators – Heather Triezenberg and Erin Jarvie

Thank you for the email in regards to your research study. With the revision/change information that you have propose and disclosed to the IRB as it is related to your current existing exempt research, it has been determined that the intended changes would not be an increase risks to participants i.e. the research does not reasonably place the subjects at risk of criminal or civil liability, damage to financial standing, employability or reputation if any disclosure of responses occurred outside of the research.

Your research can remain in the EXEMPT category. You may continue your research as proposed.

If there is an increase risk to participants at any time during the research study, please contact the IRB for further review.

Thank you,

Steven Smith

IRB Staff

517.884.6019

REFERENCES

REFERENCES

Alaska Department of Fish and Game. (2011). ADF&G Monitoring Reported Evidence of Disease Exposure in B.C. Sockeye Salmon [Press release]. Retrieved from http://www.adfg.alaska.gov/index.cfm?adfg=pressreleases.pr10212011.

Animal Plant and Health Inspection Service. (2006). *Questions and Answers About Viral Hemorrhagic Septicemia (VHS) Federal Order*. Retrieved from http://www.vet.cornell.edu/microbiology/FishDisease/AquaticProg/documents/VHSV3.pdf.

Animal Plant and Health Inspection Service. (2014). *Stakeholder Announcement: APHIS to Lift Viral Hemorrhagic Septicemia Federal Order*. Retrieved from http://www.aphis.usda.gov/stakeholders/downloads/2014/vhs_order_revocation.pdf.

Anthony, M. L., Knuth, B. A., & Bruce Lauber, T. (2004). Gender and Citizen Participation in Wildlife Management Decision Making. *Society & Natural Resources, 17*(5), 395-411.

BatchGeo LLC. (2016). BatchGeo: The Quickest Way to Map Excel Data. Retrieved from http://batchgeo.com/features/map-excel-data/.

Bruskotter, J. T., & Fulton, D. C. (2008). Minnesota Anglers' Fisheries-Related Value Orientations and Their Stewardship of Fish Resources. *Human Dimensions of Wildlife, 13*(4), 207-221. doi:10.1080/10871200802023227

California Natural Resources Agency. (2014). State Releases Final Safeguarding California Plan for Reducing Climate Risk [Press release]. Retrieved from http://resources.ca.gov/docs/press_release/State_Releases_Final_Safeguarding_California_Plan_140731.pdf.

Clarke, C. (2009). Seeking and Processing Information about Zoonotic Disease Risk: A Proposed Framework. *Human Dimensions of Wildlife, 14*(5), 314-325. doi:10.1080/10871200903096155

Connelly, N. A., Lauber, T. B., & Stedman, R. C. (2014). *Reducing the Spread of Aquatic Invasive Species and Fish Pathogens in the Great Lakes: The Role of Anglers*. Retrieved from

Covello, V. (1992). Risk Communication: An Emerging Area of Health Communication Research. *Communication yearbook, 15*, 359-373.

Crano, W. D., & Brewer, M. B. (2002). *Principles and Methods of Social Research* (2nd ed.). Boston, MA: Lawrence Erlbaum Associates, Inc. .

Cvetkovich, G., & Winter, P. L. (2003). Trust and Social Representations of the Management of Threatened and Endangered Species. *Environment and Behavior, 35*(2), 286-307.

Davis, J. J. (1995). The Effects of Message Framing on Response to Environmental Communications. *Journalism and Mass Communication Quarterly, 72*(2), 285.

Doberneck, D. M., Glass, C. R., & Schweitzer, J. (2010). From Rhetoric to Reality: A Typology of Publically Engaged Scholarship. *Journal of Higher Education Outreach and Engagement, 14*(4), 5-35.

Faisal, M., Schulz, C. A., Loch, T. P., Kim, R. K., Hnath, J., & Whelan, G. (2013). Current Status of Fish Health and Disease Issues in the Laurentian Great Lakes: 2005-2010. In W. Taylor, A. Lynch, & N. Leonard (Eds.), *Great Lakes Fisheries Policy and Management: A Binational Perspective* (pp. 880). East Lansing, MI: Michigan State University Press.

Faisal, M., Shavalier, M., Kim, R. K., Millard, E. V., Gunn, M. R., Winters, A. D., . . . Wolgamood, M. (2012). Spread of the Emerging Viral Hemorrhagic Septicemia Virus Strain, Genotype IVb, in Michigan, USA. *Viruses, 4*(5), 734-760.

Ferguson, M. (2015, April). [MDNR Creel Surveys].

Glass, C. R., & Fitzgerald, H. E. (2010). Engaged Scholarship: Historical Roots, Contemporary Challenges. *Handbook of engaged scholarship: Contemporary landscapes, future directions, 1*, 9-24.

Goniea, T. (2014). The Story of State-Licensed Commercial Fishing History on the Great Lakes. *2014*.

Gore, M., & Knuth, B. (2006). *Attitude and Behavior Change Associated with the New York NeighBEARhood Watch Program*. Retrieved from

Great Lakes Environmental Research Lab. (n.d.). About Our Great Lakes- Great Lakes Basin Facts.

Griffin, R. J., Dunwoody, S., & Neuwirth, K. (1999). Proposed Model of the Relationship of Risk Information Seeking and Processing to the Development of Preventive Behaviors. *Environmental Research, 80*(2), S230-S245. doi:http://dx.doi.org/10.1006/enrs.1998.3940.

Griffin, R. J., Yang, Z., Boerner, F., Bourassa, S., Darrah, T., Knurek, S., & Dunwoody, S. (2005). *Applying an Information Seeking and Processing Model to a Study of Communication about Energy.* Paper presented at the Association for Education in Journalism and Mass Communication Annual Conference, San Antonio, Texas.

Habron, G., Barbier, M., & Kinnunen, R. (2008). Local Understanding of Fish Consumption Advisory Risks in Michigan's Upper Peninsula: The Role of

Structure, Culture, and Agency*. *Rural Sociology, 73*(2), 275-299. doi:10.1526/003601108784514534

Heck, N., Lauber, B., & Stedman, R. (2013). *Pathogens and Invasive Species in the Great Lakes: Understanding Manger Responses Targeting Bait Dealers and Anglers*. Retrieved from

IBM Corp. (Released 2012). IBM SPSS Statistics for Macintosh, Version 22.0. Armonk, NY: IBM Corp.

Indiana Department of Natural Resources. (2005a). Largemouth Bass Virus. Retrieved from http://www.in.gov/dnr/files/LMBV.pdf.

Indiana Department of Natural Resources. (2005b). Whirling Disease. Retrieved from http://www.in.gov/dnr/files/WHIRLING_DISEASE.pdf.

Iwamoto, M., Ayers, T., Mahon, B. E., & Swerdlow, D. L. (2010). Epidemiology of Seafood-Associated Infections in the United States. *Clinical microbiology reviews, 23*(2), 399-411.

Kahlor, L., Dunwoody, S., Griffin, R. J., & Neuwirth, K. (2006). Seeking and Processing Information About Impersonal Risk. *Science Communication, 28*(2), 163-194.

Kinnunen, R. (2014). VHS Project Results Presented at North Central Region Aquaculture Conference. Retrieved from http://msue.anr.msu.edu/news/vhs_project_results_presented_at_north_central_region_aquaculture_conferenc.

Lauber, T. B., Connelly, N. A., & Knuth, B. A. (2009). *Human Responses to Viral Hemorrhagic Septicemia Virus in the Great Lakes: Stakeholder Characterization*. Retrieved from http://www.aphis.usda.gov/animal_health/animal_dis_spec/aquaculture/downloads/hdru_rpt.pdf.

Lee, J., O'Keefe, D., Oh, C.-O., & Han, J. (2015). *Improving Public Outreach and Education Programs to Minimize the Spread of Aquatic Invasive Species (AIS)*. Retrieved from http://www.miseagrant.umich.edu/wp-content/blogs.dir/1/files/2012/03/2015-AIS-Final-Report.pdf.

Lu, H. (2016). The Effects of Emotional Appeals and Gain Versus Loss Framing in Communicating Sea Star Wasting Disease. *Science Communication, 38*(2), 143-169. doi:10.1177/1075547015619173

Lundgren, R. E., & McMakin, A. H. (2013). Risk Communication: A Handbook for Communicating Environmental, Safety, and Health Risks (pp. 11-22): John Wiley & Sons.

Lute, M. L., & Gore, M. L. (2014). Stewardship as a Path to Cooperation? Exploring the Role of Identity in Intergroup Conflict Among Michigan Wolf Stakeholders. *Human Dimensions of Wildlife, 19*, 267-279. doi:0.1080/10871209.2014.888600

Lute, M. L., Gore, M. L., Nelson, M. P., & Vucetich, J. A. (2012). *Toward Improving the Effectiveness of Wolf Management Approaches in Michigan: Insights from a 2010 Statewide Survey*. Retrieved from East Lansing, MI: http://thewildlifenews.com/wp-content/uploads/2012/02/Lute_et_al_2011_Toward_improving_the_effectiveness_of_wolf_mgmt_in_michigan.pdf.

Machalaba, C. (2014). Preventing Ebola Outbreaks- The Benefits of Conservation Science. *2014*.

Manfredo, M. J. (2008). Introduction *Who Cares about Wildlife?: Social Science Concepts for Exploring Human-Wildlife Relationships and Conservation Issues* (pp. 1-27). New York: Springer.

Michigan Department of Natural Resources. (2013). *Statewide Tribal and State-Licensed Commercial Harvest and Dockside Value 2001-2013*. Retrieved from http://www.michigan.gov/documents/dnr/statewide-tribal_439281_7.pdf.

Michigan Department of Natural Resources. (2014a). Anglers No Longer Required to Keep Baitfish Receipts.

Michigan Department of Natural Resources. (2014b). *Fish Disease Control*. Retrieved from http://www.michigan.gov/documents/dnr/FO_245.10_317517_7.pdf.

Michigan Department of Natural Resources. (2014c). What is VHS?

Michigan Department of Natural Resources. (2015a). *2015 Michigan Fishing Guide*. Retrieved from http://www.michigan.gov/fishingguide.

Michigan Department of Natural Resources. (2015b). Anglers and Boaters: You are an Important Partner in Preventing the Spread of Fish Diseases and Other Aquatic Nuisance Species. Retrieved from http://www.michigan.gov/dnr/0,4570,7-153-10364_52259_10950_46202-160949--,00.html.

Michigan Department of Natural Resources. (2016a). *2016-2017 Michigan Fishing Guide*.

Michigan Department of Natural Resources. (2016b). Anglers, Beware: Help Prevent Spread of Invasive New Zealand Mudsnail [Press release]. Retrieved from http://www.michigan.gov/dnr/0,4570,7-153-10366_54559_10402-379586--,00.html.

Michigan Department of Natural Resources. (2016c). Bait Regulations Changed to Protect Against Fish Disease and Spread of Invasive Species [Press release].

Retrieved from http://www.michigan.gov/dnr/0,4570,7-153-10366_54559_10402-382553--,00.html.

Michigan Department of Natural Resources. (2016d). DNR - VHS. Retrieved from http://www.michigan.gov/dnr/0,4570,7-153-10364_52259_10950_46202---,00.html.

Michigan Department of Natural Resources. (2016e). Fish Stocking Creates Numerous Fishing Opportunities Throughout Michigan [Press release]. Retrieved from http://www.michigan.gov/dnr/0,4570,7-153-10366_54559_10402-382527--,00.html.

Michigan Department of Natural Resources. (2016f). *Memorandum to the Natural Resource Commission*.

Michigan Sea Grant. (n.d.). Viral Hemorrhagic Septicemia (VHS) in the Great Lakes.

Minnesota Department of Natural Resources. (2015). Fish diseases: Viral Hemorrhagic Septicemia. Retrieved from http://www.dnr.state.mn.us/fish_diseases/vhs.html.

National Center for Emerging and Zoonotic Infectious Diseases. (2012). Emerging & Zoonotic Infectious Diseases. In C. f. D. C. a. Prevention (Ed.).

National Marine Manufacturers Association. (2012). Economic Significance of Recreational Boating in Michigan *NMMA's Center of Knowledge, Recreational Marine Research Center at Michigan State University*.

Nemetz, T. G., & Shotts Jr., E. B. (1993). Zoonotic Diseases. In D. V. M. Michael K. Stoskopf, Ph.D. (Ed.), *Fish Medicine* (pp. 214-220). Philadelphia, PA: W.B. Saunders Company.

O'Keefe, D. J., & Jensen, J. D. (2007). The Relative Persuasiveness of Gain-Framed Loss-Framed Messages for Encouraging Disease Prevention Behaviors: A Meta-Analytic Review. *Journal of Health Communication, 12*(7), 623-644. doi:10.1080/10810730701615198

Outdoor Industry Foundation. (2006). *The Active Outdoor Recreation Economy*. Retrieved from http://outdoorindustry.org/images/researchfiles/RecEconomypublic.pdf?26.

Perrin, J. L. (2011). Emotional Responses to Environmental Messages and Future Behavioral Intentions. *Applied Environmental Education & Communication, 10*(3), 146-157.

Poortinga, W., & Pidgeon, N. F. (2003). Exploring the Dimensionality of Trust in Risk Regulation. *Risk Analysis: An International Journal, 23*(5), 961-972. doi:10.1111/1539-6924.00373

QSR International Pty Ltd. (2014). NVivo qualitative data analysis Software.

Randolph, W., & Viswanath, K. (2004). Lessons Learned from Public Health Mass Media Campaigns: Marketing Health in a Crowded Media World*. *Annu. Rev. Public Health, 25*, 419-437.

Recreational Boating & Fishing Foundation, & The Outdoor Foundation. (2014). *2014 Special Report on Fishing*. Retrieved from http://www.outdoorfoundation.org/pdf/ResearchFishing2014.pdf.

Renn, O., & Levine, D. (1991). Credibility and Trust in Risk Communication. In R. E. Kasperson & P. J. M. Stallen (Eds.), *Communicating Risks to the Public* (pp. 175-218). Netherlands: Kluwer Academic Publishers.

Riley, S. C., Munkittrick, K. R., Evans, A. N., & Krueger, C. C. (2008). Understanding the Ecology of Disease in Great Lakes Fish Populations. *Aquatic Ecosystem Health & Management, 11*(3), 321-334. doi:10.1080/14634980802301638

Riley, S. J., & Lischka, S. A. (2009). *Acceptance Capacity for White-Tailed Deer (Odocoileus virginianus) in Michigan: A Comparison of Hunters and Non-Hunters from the Upper Peninsula, Northern Lower and Southern Lower Peninsula of Michigan, 2009*. Retrieved from http://www.michigan.gov/documents/dnre/WLD_Deer_Mgmt_Plan_Appendix_F-Public_survey_report_310659_7.pdf.

Rothlisberger, J. D., Chadderton, W. L., McNulty, J., & Lodge, D. M. (2010). Aquatic Invasive Species Transport via Trailered Boats: What is Being Moved, Who is Moving it, and What Can Be Done. *Fisheries, 35*(3), 121-132. doi:10.1577/1548-8446-35.3.121

Rothman, A. J., Bartels, R. D., Wlaschin, J., & Salovey, P. (2006). The Strategic Use of Gain- and Loss-Framed Messages to Promote Healthy Behavior: How Theory Can Inform Practice. *Journal of Communication, 56*, S202-S220. doi:10.1111/j.1460-2466.2006.00290.x

Siegrist, M., & Cvetkovich, G. (2000). Perception of Hazards: The Role of Social Trust and Knowledge. *Risk Analysis: An International Journal, 20*(5), 713-720.

Siegrist, M., Cvetkovich, G., & Roth, C. (2000). Salient Value Similarity, Social Trust, and Risk/Benefit Perception. *Risk Analysis: An International Journal, 20*(3), 353-362.

Slovic, P. (1987). Perception of Risk. *Science, 236*(4799), 280-285.

Slovic, P., Fischhoff, B., & Lichtenstein, S. (1979). Rating the Risks. *Environment, 21*(3), 14.

Spence, A., & Pidgeon, N. (2010). Framing and Communicating Climate Change: The Effects of Distance and Outcome Frame Manipulations. *Global Environmental Change, 20*(4), 656-667.

ter Huurne, E. F., Griffin, R. J., & Gutteling, J. M. (2009). Risk Information Seeking Among US and Dutch Residents: An Application of the Model of Risk Information Seeking and Processing. *Science Communication*.

The Coleman Company, I., & The Outdoor Foundation. (2015). *2015 Special Report on Paddlesports*. Retrieved from http://www.outdoorfoundation.org/pdf/ResearchPaddlesports2015.pdf.

The Outdoor Foundation. (2016). *Outdoor Recreation Participation Topline Report 2016*. Retrieved from http://www.outdoorfoundation.org/pdf/ResearchParticipation2016Topline.pdf.

Throckmorton, E., Peters, A., Brenden, T., & Faisal, M. (2015). Direct and Indirect Evidence Suggests Continuous Presence of Viral Hemorrhagic Septicemia Virus (Genotype IVb) in Budd Lake, Michigan: Management Implications. *North American Journal of Fisheries Management, 35*(3), 503-511.

Triezenberg, H. A., Gore, M. L., Riley, S. J., & Lapinski, M. K. (2014a). Perceived Risks from Disease and Management Policies: An Expansion and Testing of a Zoonotic Disease Risk Perception Model. *Human Dimensions of Wildlife, 19*(2), 123-138. doi:10.1080/10871209.2014.844288

Triezenberg, H. A., Gore, M. L., Riley, S. J., & Lapinski, M. K. (2014b). Persuasive Communication Aimed at Achieving Wildlife-Disease Management Goals. *Wildlife Society Bulletin, 38*(4), 734-740. doi:10.1002/wsb.462

Tversky, A., & Kahneman, D. (1981). The Framing of Decisions and the Psychology of Choice. *Science, 211*(4481), 453-458.

U. S. Census Bureau. (2014). Michigan QuickFacts.

U.S. Census Bureau. (2016). Michigan QuickFacts. Retrieved from http:////www.census.gov/quickfacts/table/PST045215/26/ql.

U.S. Department of the Interior, U.S. Fish and Wildlife Service, U.S. Department of Commerce, & U.S. Census Bureau. (2011). 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation. Retrieved from http://www.census.gov/prod/2013pubs/fhw11-mi.pdf.

U.S. Fish and Wildlife Service. (2013). *National Fishing License Report*. Retrieved from http://wsfrprograms.fws.gov/Subpages/LicenseInfo/FishingLicCertHistory20042013.pdf.

United States Department of Agriculture. (2006). *Viral Hemorrhagic Septicemia in the Great Lakes: July 2006 Emerging Disease Notice*. Retrieved from http://www.aphis.usda.gov/animal_health/emergingissues/downloads/vhsgreatlakes.pdf.

University Outreach and Engagement. (2016). MSU Graduate Certification in Community Engagement. Retrieved from http://gradcert.outreach.msu.edu/about.aspx.

Vaske, J. J., Timmons, N. R., Beaman, J. A. Y., & Petchenik, J. (2004). Chronic Wasting Disease in Wisconsin: Hunter Behavior, Perceived Risk, and Agency Trust. *Human Dimensions of Wildlife, 9*(3), 193-209. doi:10.1080/10871200490479981

Walter, E. (2016a). [Messaging Development].

Walter, E. (2016b, February 17). [VHS Regulation Change].

Wates, N. (2000). *The Community Planning Handbook: How People Can Shape Their Cities, Towns and Villages in Any Part of the World*: Earthscan.

Wisconsin Department of Natural Resources. (2015). Fishing Wisconsin - Viral Hemorrhagic Septicemia Fish Virus. Retrieved from http://dnr.wi.gov/topic/Fishing/vhs/index.html - two.

Wisconsin Department of Natural Resources. (2016). Fishing Wisconsin - Questions about Viral Hemorrhagic Septicemia - Wisconsin DNR. Retrieved from http://dnr.wi.gov/topic/fishing/vhs/vhs_qaaboutvhs.html - three.

World Organisation for Animal Health. (2016). OIE-Listed Diseases 2016. Retrieved from http://www.oie.int/animal-health-in-the-world/oie-listed-diseases-2016/.

Zinn, H. C., & Pierce, C. L. (2002). Values, Gender, and Concern about Potentially Dangerous Wildlife. *Environment and Behavior, 34*(2), 239-256.

Zuzelski, C., & McCole, D. (2012). *Recreation Profile: Kayaking: Opportunities for Lake Huron*. Retrieved from http://www.miseagrant.umich.edu/wp-content/blogs.dir/1/files/2012/05/11-716-Kayak-Lake-Huron.pdf.