ABSTRACT

SERRANO, MARIA ELISA. The Evaluation of Wild Non-game Fish Health Surveillance and Monitoring Preparedness in the United States through the use of a Web-survey Questionnaire. (Under the direction of Michael K. Stoskopf.)

Mortality events in wild freshwater fish populations can be indicators of potential outbreaks that can affect wild game fish populations and the aquaculture industry. A proactive and effective surveillance system with consistent reporting, data collection and real time data analysis is needed to be aware of these mortality events. In our study, we assess the United States surveillance system for non-game freshwater fish through the use of a questionnaire evaluating current response level to wild carp mortality events in each of the 50 states of the US. A type I tailored mixed mode design was used where respondents were contacted by telephone initiating contact and inviting the responder to the study. Email was used to supply the link to a web based survey tool. Reminders as needed were communicated by email for the second and fourth reminder and telephone for a third reminder. The thank you response was sent by email. A 100% response rate on the questionnaire was achieved, but the data obtained supports the need for significant improvement of the U.S. reporting system for non-game freshwater mortality events.

The Evaluation of Wild Non-game Fish Health Surveillance and Monitoring Preparedness in the United States through the use of a Web-survey Questionnaire

by
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DEDICATION

To Bernie, who believed in me and supported me through it all.

BIOGRAPHY

It's 80 degrees, sweat drips down my forehead. I try to keep a grip and lift what seems like 1000 pounds. I finally plunk it down on a grassy surface, begin to scrub the edges and the cracks and then hear, "don't forget to scrub the shell." Gently, I brush away the green slimy algae between the cracks, and rinse it off with water. As I finish the weekly washing, another person comes over to help me carry it back to the tank. I think to myself, *here is a magnificent animal*, a 50 kg archaic creature. Here it is, double my size, showing no aggressive behavior while I lift it back to the tank. The green sea turtle, *Chelonia mydas*, effortlessly glides through the water as I set him free in his tank. I think to myself, *sadly, this creature is an endangered species and might not be around for my grandchildren to see*. As a junior in college, this was my first experience with a sea turtle. Although I was passionate about marine biology, working with the green sea turtles piqued my interest in aquatic wildlife conservation.

During my final year in finishing my B.S. in Marine and Freshwater Biology at University of New Hampshire, my advisor suggested veterinary school as the next step in my career. Knowing I was not interested in small or large animal medicine made it difficult to understand why my advisor made this recommendation. Entering veterinary school at North Carolina State University (NCSU), I was part of a small percentage of individuals who knew their focus was not on becoming a small or large animal veterinarian. It was not until my views were broadened by many faculty at NCSU, that I realized my advisor was right. I became aware that there are a wide variety of disciplines in veterinary medicine and there was a place and need for someone passionate in aquatics. I was able to appreciate that veterinary medicine includes all animal life forms from the microscopic plankton to marine mammals. It was this realization and passion that bolstered my determination to finish veterinary school and enroll in Fisheries, Wildlife, and Conservation masters program at NCSU. The masters program reminded me of my interest in research, epidemiology and statistics. My educational goal was always to achieve an aquatic career, and it was during veterinary school that this goal metamorphosed.

Today, my goal in aquatic veterinary medicine is to increase my knowledge of aquatic animals of all sizes. So, as a veterinarian, I don’t intend to open my own practice when I graduate. Instead, I hope to find a way that I can contribute to the field of conservation wildlife medicine both clinically and in research. In addition to clinical medicine and research, I want to teach others the importance of conservation and mentor those with similar dreams and determination.

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CHAPTER 1: INTRODUCTION

Surveillance and Monitoring

Surveillance and monitoring plays a role in animal welfare and management. It is through surveillance that data is collected and analyzed to generate knowledge and solve problems (Pfeiffer 2005). The knowledge gained from the data can be used in epidemiologic studies to identify risk factors and make policy decisions. National disease surveillance and monitoring imply a process of regular data collection used to inform risk assessment and welfare status of national or regional animal populations (Pfeiffer 2010). A proper surveillance and monitoring system is intended to detect and serve as an early warning system for new and emerging diseases (Pfeiffer 2010).

In comparison to the United States terrestrial surveillance system, aquatic biosecurity and surveillance is in the early stages of development. Spring Viremia of Carp virus (SVCV), Koi Herpes Virus (KHV), and Viral Hemorrhagic Septicemia (VHS) are three diseases where recent outbreaks have impacted the United States aquatic resources. All three diseases (KHV, SVC, VHS) have been found both in the wild and in private industry (Schlotfeld et al. 1991, Hedrick et al. 2000, Hedrick et al. 2003, Goodwin 2002, Dikkeboom et al. 2004, Grimett et al. 2006). The first documented U.S. outbreak of SVC occurred in 2002 (Goodwin 2002, Dikkeboom et al. 2004). It was detected during the investigation of a large number of mortalities in private aquaculture production facilities in North Carolina and Virginia (Goodwin 2002). In that same year, SVC was detected in wild fish in Wisconsin

(Dikkeboom et al. 2004). The first identified mass mortality due to KHV occurred in 1996 in UK and it was recently (2007) added to the Office International des Epizooties (OIE) World Organization Animal Health reportable disease list (Way et al. 2004, Sano et al. 2011). KHV has been reported in New York where 6,000 wild adult carp were found dead over an event lasting several weeks (Grimmett et al. 2006). VHS has affected populations of various species of wild freshwater fishes, including a number of ecologically and recreationally important fishes (USDA 2006). Mortality events in Michigan and the Great Lakes have emphasized the risk associated with a deficit in aquatic biosecurity surveillance as the states and federal agencies have worked to prevent the spread of VHS. An introduction or outbreak of aquatic diseases in the U.S. could deplete or diminish aquatic populations. It can impact both the aquaculture industry and wild fish populations. Not only can a disease cause great losses in our domestic production, it can also impact our economy through effects on exportation of fish. If a reportable disease is responsible for an outbreak in the U.S, this can restrict the exportation of aquatic products to other countries. For an example, a serial disease outbreak in Indonesia from March 2002 to December 2003 caused high mortalities (89-95%) to both ornamental *Cyprinus carpio* (koi) and *Cyprinus carpio carpio* (common carp), with estimated losses to that country of more than US $15 million (Sunarto et al.. 2005).

In the United States the monitoring or surveillance system for aquatic animal health is generally under the jurisdiction of individual states. The development of specific management strategies are left to individual states (Håstein et al. 2008). This can result in a large variation in response, data collection, and reporting protocols. This generates a significant risk of lack of harmonization which in turn can lead to the inability to respond appropriately to mortality events affecting non-targeted aquatic species, particularly when events cross political boundaries. It was because of recent aquatic outbreaks that the United States became more aware of the importance of the broader perspectives of aquatic animal health involving non-game fish species. This increased awareness was the basis for the development of the National Aquatic Animal Health Plan (NAAHP) in 2008. Due to the division of management and responsibility among different federal and state departments, this plan was developed through the collaboration of three cabinet level departments [Department of Agriculture, Department of Commerce, and Department of Interior (Fisheries Wildlife Service)]. The stated mission of the National Aquatic Animal Health Plan for the United States as defined by the National Aquatic Animal Health Task Force in 2008 was: "*The mission of the National Aquatic Animal Health Task Force on Aquaculture is to develop and implement a National Aquatic Animal Health Plan (NAAHP) for aquaculture in partnership and in cooperation with industry; regional organizations; state, local, and tribal governments; and other stakeholders. This plan will:*

1. *Facilitate the legal movement of all aquatic animals, their eggs, and products in interstate and international commerce;*
2. *Protect the health and thereby improve the quality and productivity of farmed and wild aquatic animals;*
3. *Ensure the availability of diagnostic, inspection, and certification services; and*

4. *Minimize the impacts of diseases when they occur in farmed or wild aquatic animals*."

The plan was not a regulation, but provided principles and guidelines for how the U.S. Federal Agencies with jurisdiction over aquatic animal health (APHIS, NOAA Fisheries, and FWS) should take action to protect farmed and wild resources (NAAHP 2008).

The descriptive study for this thesis focuses on state level response to non-game freshwater fish mortality events. Wild carp were used as a model constructs and a survey was used to assess how wild carp mortality events are responded to in each of the 50 U.S. states. The data returned was used to assess the United States of America's preparedness for response to unusual mortality events involving non-game freshwater fishes.

Carp as a Model

In this study, we used wild carp as a representative model of non-game wild fish to facilitate data collection in the survey. The study focused on several carp species (bighead carp (*Hypophthalmichthys nobilis*), black carp (*Mylopharyngodon piceus*), common carp (*Cyprinus carpio),* crucian carp (*Carassius carassius*), goldfish (*Carassius auratus auratus*), grass carp (*Ctenopharyngodon idella*), koi (ornamental *Cyprinus carpio),* and silver carp (*Hypophthalmichthys molitrix*) . These carp are widely distributed in the United Sates and are large enough and sufficiently prominent that a disease outbreak should be expected to raise concerns. Carp are affected by diseases of concern to OIE (OIE 2012) and a carp disease outbreak in the U.S. should raise biosecurity issues because of possible impacts on exportations of commercially important species.

Carp are freshwater fish belonging to the Cyprinidae family (Hoole 2001). They originated from Asian watersheds of Black, Caspian, and Arial Seas (Panek 1987). The carp species then spread throughout Europe and Asia. Carp have been introduced to more than 100 countries (Badiou et al.. 2011) and are found on every continent except Antarctica, and on numerous islands (Hayenes 2011). The common carp were first introduced in the United States in 1877, under the direction of Professor S.F. Baird, when the United States Fish Commission imported 345 the German carp (*Cyprinus carpio*) (Smiley 1883). Before 1877, there was no established carp species in the United States. After 4 years of introduction, common carp were commercially caught from Illinois, Missouri, and Mississippi rivers and

Lake Erie (Fritz 1987). By 1893, common carp were caught commercially from both the Atlantic and Pacific coast region (Fritz 1987). Now, different carp species have been reported in every state except Alaska (Table 1).

The high tolerance to broad range for temperature (39° F-106° F), and moderate tolerance for low dissolved oxygen (2 ppm, with respiratory difficulty at concentration below 4.5 ppm), and extreme for turbidity (165,000 ppm), helps carp species adapt to a variety habitats ranging from shallow weedy ponds to lakes and large reservoirs (Panek 1987). In addition to these attributes, carp are highly competitive for resources within their ecosystem often out competing native species (Hayenes 2011). They can quickly establish populations in new, unexploited, and disturbed habitats. Once established, they are capable of achieving massive population densities and dominating waterways to which they have been introduced (Hayenes 2011). Though for many years carp have played an important role in food stocks, aquaculture, sport interests, and ornamental display animals, the artificial spread of carp by humans to new habitats has resulted in perceptions of the carp as an undesirable species in many states in the United States (Hoole 2001)

Carp Diseases

In addition to carp competing with native species, they can act as potential disease vectors (Hayenes 2011). The introduction of carp into the U.S. waters has resulted in introduction of significant fish diseases. Carp are carriers of and susceptible to many pathogens including a wide range of bacteria and viruses (Table 2). In carp, diseases of concern for the OIE are Koi Herpes Virus (KHV) and Spring Viremia of Carp Virus (SVC) (OIE 2012).

SVC

Spring Viremia of Carp (SVC), is a contagious RNA rhabdovirus with a single genotype (I) that is divided into four subgroups, differentiated geographically. These subgroups are: subgroup a (isolates from Asia), subgroup b (isolates from Moldova and Ukraine, Eastern Europe), subgroup c (isolates from Ukraine and Russia, states of former USSR), and subgroup d (isolates from Western Europe) (Dixon et al. 2008, Graver et al. 2007). The North American SVC isolates are classified into genogroup Ia (Graver et al.. 2007). The list of known primary hosts of this virus include several cyprinid species [bighead carp, goldfish, crucian carp, grass carp, common carp, silver carp, koi, orfe (*Leuciscus idus*), tench (*Tinca tinca*), roach ((*Rutilus rutilus*)]. All of these fish species except the roach, are introduced into the United States. SVC has also been isolated in non-cyprinid species including the native *Esox lucius* (northern pike), the introduced *Oncorhynchus mykiss* (rainbow trout), *Silurus glanis* (sheatfish), and cultured in penaeid shrimp (Dixon et al. 2008, Anhe 2002). Clinical external and internal signs of the disease are not specific to SVC and can be easily confused with bacterial infections. External clinical signs associated with SVC include exophthalmia, pale gills, ascites, and hemorrhages of skin, gills, and anterior chamber of the eye (Petty et al. 2002, Goodwin 2009). Internally the fish may have petechial hemorrhages of the swim bladder and muscle, ascites, fluid accumulation in the kidney, liver and spleen, and enteritis and the accumulation of viscous mucous (Goodwin 2009). As the fish's health declines, it may display lethargy, loss of equilibrium, uncoordinated swimming, exophthalmia, and decreased respiration rates (Dikkeboom et al. 2004).

Because fish are poikilotherms, environmental temperature plays a role in the disease process affecting the reproduction rate of the virus and the host immune response (Walker 2010). Temperature has a decisive influence determining the course and outcome of SVC infection. When temperature rises toward 10°C, fish develop clinical signs and peak mortality is seen at temperatures of 15-17°C. At 20°C, fish exposed to SVC don't develop clinical signs but do develop humoral immunity response (Ahne 2002). It is for this reason SVC can be expected from November to July with a peak in April-June (Fijan 1999, Sano et al. 2011). The production of antibodies against SVC is influenced by the age and condition of the fish, route of infection, and temperature (Sano et al. 2011).

The virus is transmitted horizontally (Goodwin 2009). Although it is thought to not be transmitted by mechanical or vertical transmission (Goodwin 2009), it potentially has been reported in vector transmission with carp louse and leech (Pfeil-Putzien 1977). It has been found excreted in feces, urine, and mucous (Ahne 2002). Once SVC is established, it can be difficult to eradicate. The virus can be infective in the water for more than 4 weeks and mud for about 6 weeks at 4-10°C (Goodwin 2009). In addition to its persistence in the environment, reservoir hosts may serve as carriers (Ahne 2002). To differentiate SVC from other diseases, it needs to be diagnosed by virus isolation or direct immunofluorescence tests or enzyme-linked immunosorbent assays (OIE aquatic manual 2011).

SVC was first diagnosed in 1971 in Yugoslavia (Dikkeboom et al. 2004). It now has been identified in many other countries: Russia (Petty et al. 2002), Belarus, Georgia, Lithuania, Moldova, Ukraine (Sano et al. 2011), the Middle East (Petty et al. 2002), China (Garver et al. 2007, Dixon et al. 2008), Brazil (Dixon et al. 2008), USA (Goodwin 2002), Canada (Garver et al. 2007), and in other European countries (Petty et al. 2002). The first reported case in the United States occurred at a North Carolina private koi farm in April and May 2002 (Goodwin 2002). Since then there have been other reports in the US, including wild common carp in 2002 in Wisconsin (Dikkeboom et al. 2004), in 2003 from common carp in Illinois, and 2004 from cultured koi in Washington state and Missouri (Warg et al. 2007, Garver et.al 2007).

SVC, is a highly contagious disease and difficult to eradicate. It can cause a substantial economic loss to the carp aquaculture industry and the ornamental fish trade. During outbreaks, mortality rates in young carp can be up to 70% and yearly losses of adults up to 30% (Ahne 2002). After the first outbreak in the United States the Animal Plant Health Inspection Service authorized $11.7 million to implement a SVC control and indemnity program (Dixon et al. 2008). In 2006, the USDA-APHIS restricted importation of live fish, fertilized eggs, and gametes of fish species susceptible to (JAVMA 2006).

KHV

Another critical and emerging disease of freshwater fishes, KHV is a highly contagious DNA virus, cyprinid herpes virus 3 that was added to the reportable OIE disease in 2007. KHV is known to cause disease in all ages of common carp and koi (Dixon et al. 2008). It can cause mass mortality in both cultured and wild environments. KHV has been identified in wild carp in Japanese freshwater systems (Uchii et al. 2009), in New York (Grimmett et al. 2006), and recently the presence of KHV was detected in June 2011 Michigan common carp fish kill (Michigan Department of Natural Resources 2011).

Once KHV infects a fish, the external clinical signs can be variable. Discolored, necrotic, inflamed gills and increased mucous production are consistent with a diagnosis of KHV (Dixon et al. 2008). A list of other clinical signs include pale discoloration or reddening of skin, hemorrhagic fins, disorientation, anorexia, rapid respiration, and lethargy with occasional periods of hyperactivity (Dixon et al. 2008). Similar to SVC, temperature also plays an important role with the onset and severity of KHV infection. Fish develop clinical signs and the KHV disease at temperatures ranging from 16-28°C (Dixon et al. 2008). In experimental situations, fish infected at 13°C did not show signs of the disease but viral DNA was detected by PCR (Dixon et al. 2008). Other evidence of possible reservoir hosts was found in the KHV outbreak in wild carps in Japan, where KHV was still persistent in surviving fish, and transmission continued after the initial outbreak ended (Uchii et al. 2009). Fish that survive an infection may become carriers of the virus as is the situation with other herpes virus infections (Palmeiro et al. 2010). It is possible that active infection causes the production of antibodies in the host and the survivors then can resist further challenges of KHV. The herpesvirus also has the ability to persist in a latent state and remain dormant and noninfectious for periods but can also become reactivated to result in clinical disease or shedding of the virus (Palmeiro et al. 2010).

The research on transmission of KHV is on-going. Research has indicated that KHV is transmitted horizontally rapidly (Pokorova et al. 2005). Fish are infected by direct contact with infected fish's fluid or contaminated mechanical fomites including water and mud (Pokorova et al. 2005). Once a fish is in contact with the virus, the virus particle enters through the gills where it replicates (Pokorova et al. 2005). The virus attacks epithelial cells which results in the excessive mucous shedding, dry feeling skin, and dead gill cells (Yosha 2003). More research is needed to determine if KHV can be vertically transmitted.

At this time, there is no definite test available to diagnosis KHV. It is best diagnosed with a combination of cell culture, PCR, and immunodiagnostic methods (OIE Aquatic Manual 2011). Among these, PCR based essays to detect KHV genomic DNA are considered currently to be the most sensitive and reliable methods and have been used preferably in diagnostic institutions worldwide (Sano et al. 2011). To detect previous exposure to the virus with no active shedding, detection of KHV antibodies is the best option (Way 2008).

KHV is an emerging disease with a wide geographic distribution. The first KHV outbreaks occurred in Israel and the USA in 1998 (Hedrick et al. 2000). But evidence of the virus was found as early as 1996 in archival tissue samples from a mass mortality of common carp and koi in UK (Way et al. 2004). The virus has been detected in at least 26 countries (Sano et al. 2011). KHV has been known to occur in fish imported into Israel, South Africa, and European and Asian countries (Dixon et al. 2008). In the United States KHV has been reported in the mid-Atlantic region (Hedrick et al. 2000), New York (Grimmett et al. 2006), and recently in Michigan (Michigan Department of Natural Resources).

In addition to its wide geographic distribution, KHV can cause mass mortality. This could impact the structure of aquatic communities and freshwater ecosystem function (Matsui et al. 2008). Because KHV is highly contagious with rapid mortality rates, it can cause major economic impacts on common carp and ornamental koi aquaculture. In addition the presence of carrier fish makes control of the disease difficult in ornamental trade (Sano et al. 2011) Currently, there is no treatment for KHV and SVC other than eradication by clearing infected sites of fish, followed by disinfection. Recently, there is a KHV vaccine produced by Novartis to help prevent KHV. Other than this vaccine for KHV the best prevention for KHV is good biosecurity and quarantine control.

Other important carp diseases:

Carp like other freshwater fish are affected by many other viruses besides KHV and SVC (Table 2). Although these are of great concern due to their economic impact, other viral diseases of carp include carp pox, goldfish hematopoietic necrosis virus (HVHN), and grass carp hemorrhagic disease (GCHD).

Carp pox, cyprinid herpesvirus 1, (herpesviral epidermal hyperplasia) causes epidermal hyperplasia in fish in low water temperature and the lesions regress as the water temperature increases (Lewbart 1998). Although it is a herpesvirus like KHV, this disease is rarely fatal and is self limiting (Lewbart 1998). In contrast a new herpesvirus causing signs similar to KHV, HVHN, associated with necrosis of hematopoietic tissue and anemia with high mortality in all varieties of gold fish has been reported (Goodwin et al. 2006, Palmeiro et al. 2010).

Another virus of concern, especially in China is grass carp hemorrhagic disease (GCHD). GCHD, caused by a reovirus, is a major disease of major economic importance in China with mortalities reaching 80% (Hole 2001). It has been reported in the U.S. but no clinical disease was seen in that situation. Currently, there is very little information on the pathogencity and transmission of this disease (Hole 2001).

Regulatory Concerns about Carp

KHV and SVC, two emerging diseases, have not only put the carp population in the spot light, it has also emphasized the importance of monitoring and controlling fish populations. Effective October 30, 2006, the Department of Agriculture's Animal and Plant Health Inspection Service restricted importation of fish susceptible to SVC. This restriction includes live fish, fertilized eggs, and gametes of fish species (Federal Register Vol 71, No. 187). It also prohibited the shipment and importation of specific carp species in efforts to control their populations and reduce their impacts on ecosystems (Fed register Vol 72, No. 131, Fed register Vol 72, No. 201).

Unlike SVC, the importance and implications of KHV is just starting to become realized. KHV was just added to the OIE of reportable diseases in 2007. At this time, there are no mandatory actions with the USDA regarding KHV. It is recommended that certified veterinarians and laboratories report positive cases so that USDA can keep track of its occurrences. But there is no surveillance program to monitor the occurrence of KHV in the wild, no restriction on importation, and no mandatory depopulation for infected koi population. The need to understand how the direct mass mortality and the resulting indirect impacts on the ecosystems and societies must both be considered when evaluating consequences of disease outbreaks (Matsui et al. 2008).

Case management, population care, disease management have the same goal, to improve health outcomes for a population. Now more than ever, there is a need to monitor and increase awareness of health issues in the carp population. More surveillance of this population can provide information on the geographic distribution expansion, their effect on ecosystems, and the impact of introduced pathogens that carp carry like KHV and SVC.

Emerging diseases like KHV and SVC have peaked interest in monitoring and surveillance of the carp population. Although in some areas of the United States carp are an introduced nuisance, to others it may play an important economical role in aquaculture, sport fishing, and ornamental industries. Regardless of the threat, it is important to learn how it affects the population and the ecosystem and how to prevent its future impacts. Information and knowledge is important when it comes to controlling a disease. Because there is already little information known about these threats to the population, it is essential to monitor the population, and prevent decline in carp and other species.

The Importance of Carp:

Carp are one of North America's most widely distributed and underutilized fishery resources (Fritz 1987). They are a hardy abundant species that are long lived and tolerate a wide range of environmental conditions. If a carp population is at risk or negatively impacted by a disease, it is possible other less hardy species may also be affected. Although carp are introduced, they have become established and are in contact with other natural and economically important species. We need to deal with the consequences that they are indeed permanent residents, for better or worse (carrying disease and introducing disease). We can't ignore what disease affects them or expect that because they are an introduced and nuisance species no biosecurity is needed.   Little is known how many diseases affecting carp may also affect native or economically species. Carp can be a helpful tool as sentinel species for environmental factors or infectious disease. " Man can shout off chemical abuse and undo physical damage, … but an aquatic organism, once established, is indeed a permanent resident, for better or worse" quoted by C.R. Robbins 1986, (William 1997).

The Complex Process of Survey Science

Surveys or questionnaires are useful methods used in research to collect information and learn about a particular target population. Often when discussing surveying, the focus is incorrectly placed only on the survey instrument and how it is administered to the survey sample, and not on the entire survey objectives (Schonlau 2002). The methodology is a complex process where researchers need to consider many aspects in its development. The design of a survey study involves defining an objective, developing a sample frame, developing a strategy for data collection, and conducting the appropriate analysis (Schonlau 2002).

The first and important step in the design is defining the objective. The objective defines what the researcher wants to learn from the population, the goal of study, and identifies the population of interest and the type of data that will be collected. It leads to the development of the sample frame, how the data will be collected, and what is done with the data once the study is done. In defining the sample frame, the researcher decides what population is to be considered for the study and if it will focus on the whole or partial population. The method of sampling, probability based or convenience based is also identified (Schonlau 2002). After an objective is defined and a sample frame is chosen, a strategy for data collection is developed. Many elements need to be considered when considering how the data will be collected, including response rates, the social exchange theory, time lines, and source of error. In addition, the survey delivery contact, and follow-up mode (phone, mail, face to face interview, email, internet) needs to be considered. Response rates are a measure of the number responses during the sample frame. The higher the response rate, the lower the non-response bias and this increases the precision of the results.

The concept of tailored survey design was created to optimize response rate and data collection. The tailored design "*involves using multiple motivational features in compatible and mutually supportive ways to encourage high quantity and quality of response to the surveyor's request*" (Dillman et al. 2009). It is developed on the theory of social exchange of human behavior, which attempts to explain the development and continuation of human interaction. The individuals are motivated by the expectations of returns that the particular action will bring. These actions are predicted by rewards, costs, and trust (Dillman 2007). "*Rewards are what one expects to gain from a particular activity, costs are what one gives up or spends to obtain the rewards, and trust is the expectation that in long run the rewards of doing something will outweigh the costs*" (Dillman 2007).

The tailored design method (TDM) modifies the technique to the responding population. It involves many important factors when implementing a questionnaire, defining an objective, developing a sample frame, questionnaire design, and conducting the appropriate analysis (Schonlau 2002). The design also takes into consideration many aspects of the survey tool including question design (type of question, how the question will be worded, reliability and validity), appearance of the survey instrument (order of the questions, instructions, color, visuals), pre-testing the survey, what survey mode (mail, telephone, email, web based, fax, mixed mode), and strategy for implementing the survey (pre-notification, cover letter, post delivery reminder, thank you, and non responsive follow ups). In order to modify or adapt to the current population, many study design involves mixed mode, a combination of different survey modes to improve survey quality and quantity.

Another aspect in Dillman's TDM is the application of the procedure to achieve high quality and quantity. Higher response rates can be obtained by trying to identify with the respondents (in this study largely fish and wildlife agencies), "*Most people identify with certain groups on supporting person's values can instill a sense of reward in individuals*" (Dillman 2007). Offering incentives can further enhance the response rate. In the social exchange theory, when respondents are offered rewards, they will weigh the value of incentive against their perceived cost in time and effort (Sue et al. 2007). When there is a lower cost to the respondent, it improves timelines, reduces coverage error, delivers incentives, and improves response rates and decrease non-response error, therefore reducing measurement error (Dillman et al. 2009). Besides decreasing the respondents cost, telling the respondent approximately how long it will take to complete the questionnaire will help to improve response rate (Dohoo et al. 2003).

In addition to reducing social cost, studies have indicated that when reminders are carefully and strategically sent at specific times, return rates improve. Carefully and strategically sending the survey at specific times allowed the respondent adequate time to process the survey and reduce the chance of it being forgotten. A previous study suggested that one follow up message sent about one week after the initial email invitation is optimal (Kittleson 1997). It is important that reminders are not sent too frequently, or in a pushy manner, because such emails can be quickly dismissed and forgotten (Dillman et al. 2009). Another study discovered that sending reminders late in the day or early in the morning had the most effect in terms of increased response rate (Sue et al. 2007, Dillman et al. 2009).

Pilot Study (Consequences of Not Using a Tailored Design Method)

For the project that forms the basis of this thesis, a pilot study was done that provided an initial assessment of the level of interstate harmonization of data collection and communication focusing on carp mortality events. The preliminary objective was to contact the appropriate individuals from each state that would have data relevant to the disease status of wild carp in their state. The second objective attempted to construct a database of wild carp mortality events from 2000 to 2007. This study was an opportunity to evaluate the readiness of the state and federal government infrastructure to respond to an OIE relevant outbreak in a non-commercial wild fish species.

Using initial contact information provided by the national coordinator of aquatic animal health for the USFWS, each of the 50 states' wildlife agencies was contacted by email or by phone. Efforts to locate the appropriate individual from each state who would have data relevant to disease status of carp in their waters were done with the combination of internet, phone directories, and reference from other governmental agencies. The study was planned in a manner to simulate the situation that might be encountered in a real effort to establish an understanding of an arising issue. Once the appropriate personnel were identified, an email or phone call was made to gather information pertaining to carp mortality events. At this time, data was also requested concerning carp mortalities. The responses were classified as follows: states responding with either yes or no to carp mortalities were classified as a state that has replied and states that reported carp mortalities but did not provide location were classified as providing limited data.

After extensive effort and several weeks, this study was able to establish useful contact with 43 states. This was a greater response than expected because finding the initial contact for each state fish and wildlife was not as clear as proposed. In one case communication efforts bounced between six different individuals. Overall response to the queries was very slow and sometimes involved a final reference to an unmanned website rather than a person. Only one contact was made where the first contact was successful in obtaining information. It was common during this study that multiple tries reaching multiple individuals were necessary before access of data was achieved. When speaking to the individuals, no contact was aware of a maintained list of contacts related to fish health across state and federal agencies. It appeared there was no communication tool in place.

Of these 43 states, 15 states reported no carp mortality in 2000-2007. Among the 28 states that did report kills involving carp, 46% (13) provided carp mortality data with location of carp kills. A total of 116 events were provided, and of these 110 provided valid location. From these events, unspecified assessments attributed 15 of 110 events to be related to pathogens rather than to environment. The pathogens suspected involved included koi herpes virus (KHV), *Flavobacterium columnare*, mixed bacterial septicemia, unspecified viral disease, spring viremia of carp (SVC), unknown, *Cytophaga* spp., *Aeromonas* spp., and unspecified gill trematodes. Many of the individuals reported that diagnostic work was relatively rarely deployed for carp mortalities and the efforts were limited and variable by state. Despite the assignment of some mortality causes due to pathogens or environmental causes, not all the cases were completely worked up diagnostically and there was no clear balanced collection of water quality parameters.

In this pilot study, the appropriate contact was not made for seven states. Initial contact was made with one of these states at one instance in 2006, but no further response was received at later attempts to communicate.   The dates and location of mortality events involving carp reported by participants in this pilot data can be seen in the appendix (Appendix A).
To best understand how disease impacts the wild carp population, the population needs to be monitored and appropriate record keeping needs to be maintained. This retrospective pilot study's initial objective was to contact each state agency to understand how the carp population has been affected since the first reportable (2002) event of SVC in the United States.

The response was sluggish and incomplete. There are many factors that may have contributed to the low response rate and incomplete data. This retrospective study with data collection is similar to surveys. Surveys are largely dependent on compliance to answering a questionnaire and that surveys are entered completely and with accuracy. There is a possibility that states that did not respond may have had carp mortalities and chose not to answer the email. This increases the non-response bias in the study. This study was also limited by size because there are only 50 states. Another factor for sluggish or no response could be because the individuals were contacted by a lower ranking individual who identified themselves as working to collect information for the UFWS and not by the National Coordinator personally.

Although 43 states responded, 46% were only able to provide location of the carp mortalities. The low percentage of providing actual data with locations can be due to numerous factors. A few of the responses mentioned carp is not monitored as closely as other freshwater fish because of limited monitoring or carp are often considered a nuisance. Other responses included that the data was available but needed to be compiled and sent by email on a later date. The study also relied on the participant to recall information and this could largely be affected by recall bias. A portion of the participants responded what they thought off the top of their head while others actually provided data from their data base. Further contributing to the delay in gathering information was the fact the data were routinely not in a condition to allow ready access to the desired data and in many cases it took several days for contacts to extract the basic data requested. The timing when the emails were sent was not the most convenient time for the respondents. The pilot email survey was done between March and April, and spring for many of the respondents is the busiest time of the year.

The collection of this information was very similar to survey science; therefore the low response rate and low yield of data could be because of the methodology or study design. In survey science, the methodology is a key factor in response rate and the quality of the data. This pilot study did not have a set protocol on how the respondents would be contacted and reminded for the data. This pilot study was a great example of how important study design can be in survey studies. For example, how something as simple as timing of the survey, can provide a study with or without data. Even the wording of the questions of the email were sometimes perceived as confusing and led to respondent not knowing what the researcher wanted in terms of data.

Currently, besides the carp mortality that has been reported due to SVC there is no compiled information that includes the cause and location of carp kills in the United States. A website is available through the USFWS that contains information pertaining to current survey sites. This information is focused on current survey sites and does not include new areas that may have had past carp mortalities.

Although this pilot study appears incomplete, it was a starting point for the future study. This pilot study initiated some contacts for state wildlife agencies and emphasized the importance of survey science methodology.   Locations of carp kills that were established can lead to future survey sites for future monitoring of the carp population.

Second Attempt, Using a Tailored Design Method

Due to low response rate from the pilot study, a new study design was attempted using a tailored survey mixed mode design with web-surveys as the delivery mode. Respondents were contacted by one mode and encouraged by a different mode, a type I tailored mixed mode design (Dillman et al. 2009). It was thought that using a mixed mode including the web based survey approach would be superior to more expensive or time consuming methods such as a postal surveys or phone interview. A web-survey sent by email was thought to be the most effective mode for this population with access to internet and vastly geographically distributed sites throughout the United States. This mode was also used because of its benefits of quick turnaround time and low cost to the researcher (Sue et al. 2007).

This study sampled the whole population, generating a census of one state official, fish health specialist, director of fisheries, fish health biologist or chief of fisheries, from each of the 50 states. It focused on a general census of this population to assess the response to non-game freshwater mortality events. In this second attempt, in order to achieve a lower non-response bias, a goal was to achieve a high response rate.   Although many non-game freshwater fish are important to the aquatic animal health assessment in United States, most are not viewed popularly by both the public and state agencies. It was thought it would be beneficial to obtain information from the target population, the state agencies, and gain more knowledge how these non-game fish are monitored. A questionnaire was used to generate a descriptive study on what information is available on a state by state basis related to non-game freshwater fish mortality, using carp as a model.

There is limited research with no clear effects on web-based surveys on the target population. A previous nationwide survey of stage agencies (all state wildlife agencies) regarding hunter harvest survey techniques resulted with a 96% (n=48) response rate. The study did not receive responses from Hawaii and Utah (Rupp et al. 2000).

Another aspect of survey science to consider is how costly the study is for the researcher. Costs are what one gives up or spends to obtain rewards (Dillman 2007). A study that has large cost with minimal results in the end yields small benefits. The time required for developing, testing, and distributing the questionnaire should be considered when designing a survey study. In comparison to other modes, web-survey's unit cost of data collection is low with potential high speed returns having all the advantages of self administered survey instruments (providing time for thoughtful answers and checking records) (Fowler 2009).

This study took into consideration the complexity of survey development and distribution to obtain high response rate and data quality. A questionnaire was developed that focused on wild carp mortality events for each state. The data presented in this thesis was used to assess the United States of America's preparedness for response to unusual mortality events involving non-game freshwater fishes. The rest of the thesis focuses on what this data can tell us about the United States' aquatic animal health infrastructure and the methodology used to achieve this data.

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Table 1.1 Established or recorded invasive carp species in the United States (Schofield 2005)

State	Invasive fish species	State	Invasive fish species
Alabama	Silver Carp X Bighead Carp, Bighead carp, Silver carp, Grass carp, Common carp, Goldfish	**Missouri**	Silver Carp X Bighead Carp, Bighead carp, Silver carp, Black carp, Grass carp, Common carp, Goldfish
Alaska		**Montana**	Goldfish, Common carp
Arizona	Grass Carp X Bighead Carp, Bighead carp, Grass carp, Common carp, Goldfish	**Nebraska**	Bighead carp, Silver carp, Grass carp, Common carp, Goldfish
Arkansas	Bighead carp, Silver carp, Black carp, Grass carp, Common carp, Goldfish	**Nevada**	Grass carp, Common carp, Goldfish
California	Bighead carp, Grass carp, Common carp, Goldfish	**New Hampshire**	Grass carp, Goldfish
Colorado	Bighead carp, Silver carp, Grass carp, Common carp, Goldfish	**New Jersey**	Grass carp, Common carp, Goldfish
Connecticut	Grass carp, Common carp, Goldfish	**New Mexico**	Grass carp, Common carp, Goldfish
Delaware	Grass carp, Goldfish, Common carp	**New York**	Grass carp, Common carp, Goldfish
Florida	Grass Carp X Bighead Carp, Goldfish x common carp, Bighead carp, Grass carp, Common carp, Goldfish	**North Carolina**	Grass carp, Common carp, Goldfish
Georgia	Grass carp, Common carp, Goldfish	**North Dakota**	Grass carp, Common carp, Goldfish
Hawaii	Silver carp, Grass carp, Common carp, Goldfish	**Ohio**	Bighead carp, Grass carp, Common carp, Goldfish
Idaho	Grass carp, Common carp, Goldfish	**Oklahoma**	Bighead carp, Grass carp, Common carp, Goldfish
Illinois	Bighead carp, Silver carp, Black carp, Grass carp, Common carp, Goldfish	**Oregon**	Grass carp, Common carp, Goldfish

Table 1.1 Continued

Indiana	Bighead carp, Silver carp, Grass carp, Common carp, Goldfish	**Pennsylvania**	Grass carp, Common carp, Goldfish
Iowa	Bighead carp, Silver carp, Grass carp, Common carp, Goldfish	**Rhode Island**	Common carp, Goldfish
Kansas	Bighead carp, Silver carp, Grass carp, Common carp, Goldfish	**South Carolina**	Grass carp, Common carp, Goldfish
Kentucky	Silver Carp X Bighead Carp, Bighead carp, Silver carp, Grass carp, Goldfish, Common carp	**South Dakota**	Bighead carp, Silver carp, Grass carp, Common carp, Goldfish
Louisiana	Bighead carp, Silver carp, Black carp, Grass carp, Common carp, Goldfish	**Tennessee**	Bighead carp, Silver carp, Grass carp, Common carp, Goldfish
Maine	Common carp, Goldfish	**Texas**	Silver Carp X Bighead Carp, Grass Carp X Bighead Carp, Goldfish carp x Crucian carp, Bighead carp, Grass carp, Common carp, Goldfish, Crucian carp?
Maryland	Grass carp, Goldfish, Common carp	**Utah**	Grass carp, Common carp, Goldfish
Massachusetts	Grass carp, Common carp, Goldfish	**Vermont**	Common carp, Goldfish
Michigan	Grass carp, Common carp, Goldfish	**Virginia**	Bighead carp, Grass carp, Common carp, Goldfish
Minnesota	Bighead carp, Grass carp, Common carp, Goldfish	**Washington**	Grass carp, Common carp, Goldfish
Mississippi	Bighead carp, Silver carp, Black carp, Grass carp, Common carp, Goldfish	**West Virginia**	Bighead carp, Grass carp, Common carp, Goldfish

Table 1.1 Continued

Missouri	Silver Carp X Bighead Carp, Bighead carp, Silver carp, Black carp, Grass carp, Common carp, Goldfish	**Wisconsin**	Grass carp, Common carp, Goldfish
		Wyoming	Grass carp, Common carp, Goldfish

Table 1.2 List of viral and key bacterial disease that are known to occur in carp.

Viral diseases that can occur in carp	**Common bacterial infections reported in carp**
Spring Viremia of carp (Fijan et al. 1971, Fijan 1972)	*Flavobacterium columnare (Flexibacter columnaris)*(Bootsma & Clerx 1976)
Koi Herpes Virus (cyprinid herpesvirus 3) (Bertzinger et al. 1999)	*Aeromonas hydrophila-puncta (*Farkas & Olah 1982*)*
Pike Fry Virus (Haenen & Davidse 1993)	*Aeromonas salmonicida* (Plehn 1911,Mawdesley-Thomas 1969)
Herpesviral Epidermal Hyperplasia (Cyprinid herpesvirus 1) (Gessner 1563 as cited by Mawdesley-Thomas 1967	*Mycobacterium* spp. (Bataillon et al. 1897)
Herpesviral Haematopoietic Necrosis (cyprinid herpesvirus 2)(Jung et al. 1995)	*Edwardsiella tarda(Sae-Oui et al. 1984)*
Grass Carp Haemorrhagic disease (McEntire et al. 2003)	Lactic Acid Bacteria (Michel et al. 1986)
Golden Shiner Virus (Hedrick et al. 1989, McEntire et al. 2003)	*Vibrio cholerae* (Reddacliff et al. 1993)
Carp Edema (koi sleepy disease) (Ono et al. 1986)	*Proteus rettgeri* (Bejerano et al. 1979)
Viremia-associated ana-aki-byo (Miyazaki et al.. 2000)	*Yersinia ruckeri* (Fuhrmann et al. 1984)
Goldfish virus 1 (Berry et al. 1983)	*Pseudomonas* spp.*(Bullock 1965)*
Goldfish virus 2 (Berry et al. 1983)	*Cytophaga* spp.(Lehmann et.al 1991)
Warm spring virus (Iwanowicz et al. 2000)	*Staphylococus aureus* (Shah & Tyagi 1986)
Infectious pancreatic necrosis(Adair & Ferguson 1981)	*Bacillus cereus* and *Bacillus mycoides* (Pychynski et al. 1981)

Table 1.2 Continued

Crucian carp haematopoeitic necrosis virus (Fukcuda, H. as cited by Somamoto et al. 2002)	*Streptococcus milleri* (Austin & Robertson 1993)
Viral Systemic Necrosis of carp (Oh et al. 2001)	*Epitheliocystis* spp. (Plehn 1920 cited by Nowak et al. 2006, Paperna & Sabnai 1980)
Coronaviridae-unnamed virus (Yanez et al. 1980)	
Cyprinid coronavirus 1, Coronavirus Cyprini, carp coronavirus (Sano et al.. 1988. as cited in Dixon et al. 2008	

CHAPTER 2: USE OF A WEB-SURVEY QUESTIONNAIRE TO THE STUDY UNITED STATES' PREPAREDNESS TO RESPOND TO UNUSUAL MORTALITY EVENTS INVOLVING NON-GAME FRESHWATER FISHES

ABSTRACT

A questionnaire focused on wild carp mortality events was developed to survey individual state preparedness to respond to non-game freshwater fish mortality events. A type I tailored mixed mode design was used where respondents were contacted by telephone initiating contact and inviting the responder to the study. Email was used to supply the link to a web based survey tool. Reminders as needed were communicated by email for the second and fourth reminder and telephone for a third reminder. The thank you response was sent by email.

INTRODUCTION

A need to assess the current national capability to collect and evaluate data on non-game freshwater fish mortality events presented several challenges. Obtaining information from state agencies about how non-game fish are monitored by each state was an obvious step. However, the variability in assignment of regulatory responsibility for this activity made it necessary to first identify which state official, fish health specialist, director of fisheries, fish health biologist or chief of fisheries, should be surveyed for each state. A desire for the best possible data return rate to provide a comprehensive picture of the overall US capacity required that the methods developed not overwhelm respondents and encourage a timely response for information requests. A tailored survey design was used to optimize response rate and data collection.

A tailored design survey uses multiple motivational features to encourage high quantity and quality of response (Dillman et al. 2009). The foundation of the tailored design is based on the theory of social exchange of human behavior that individuals are motivated by expectations of returns from an action, and that those actions can be predicted by evaluating the rewards, costs, and trust associated with the action (Dillman 2007). Rewards can be tangible, like a token incentive or money, or non-tangible, like providing appreciation or the knowledge they have helped others. The term "trust" refers to expectations that the long term rewards for an action will outweigh the costs or what a respondent sacrifices to complete the activity. Costs related to responding to surveys can include the time spent responding, loss of control of data provided, or even detrimental agency outcomes that result from the eventual evaluation of the data provided.

Creating a tailored design requires the basic steps of defining a clear objective of the survey, developing a data sampling frame, and designing a questionnaire that can be appropriately analyzed (Schonlau 2002). Beyond that foundation, many aspects of a tailored design survey tool must be carefully integrated, including specific question design, and the overall appearance of the survey instrument including the optimal order of questions, instructions, and even color selections. These are all made with an understanding of what survey mode (mail, telephone, email, web based, fax, or mixed mode) will be employed. Pre-testing the survey to evaluate the impacts of the survey tool structural choices can be very beneficial to the yield of the study. The strategy for implementing the survey optimally will include multiple components designed to modify or adapt the potential respondent's perceptions to improve the survey response rate and the quality of the data returned. These components including a pre-notification, the cover letter for the survey tool, the survey tool, a post delivery reminder, a reward communication of thanks, and even follow up communication tools for both respondents and non respondents.

There is very little published information on the relative efficacy of survey delivery approach for veterinary epidemiological studies. A web based survey tool has advantages of relatively low costs to the investigator and the potential for relatively quick turnaround of communications (Sue et al. 2007). Web based surveys are also attractive when the population to be surveyed is geographically widely distributed and expected to have internet access. If the participants who are being surveyed are concentrated in a narrow region, other methods like telephone or face-to-face interviews maybe more feasible (Sue et al.. 2007). Web-based survey was thought the best tool for this study because of the geographically widely distributed state agencies and assumption of internet access.

We present here an assessment of the efficacy of a tailored mixed mode survey utilizing a web-based questionnaire to collect information indicative of capacity to respond to freshwater fish mortality events from appropriate state agencies. The objectives of this study was to first develop an approach that established a relationship with state agencies responsible for monitoring wild carp in the United States, and to obtain information on past, present, and future wild carp mortality events. Secondly, to achieve an adequate response rate, greater than 50%, by using a tailored mixed mode design method involving both the phone and e-mails correspondences.

MATERIALS AND METHODS

Development of Contact List

A contact list to generate the phone numbers for recruitment of the appropriate state official for the survey was developed using several approaches. A list of phone numbers was generated during a pilot project focused on identifying the appropriate state fish health specialist for each state. This pilot study had an initial list of contacts provided by the US Fish and Wildlife Service National Aquatic Animal Health Coordinator. For a large portion of this list the contact information was incorrect or not productive. This method lead to a large number of redirected phone calls until the correct person was located. For states with dead end contacts, websites of the particular state fish and wildlife agencies were searched. The National Association of State Aquaculture Coordinators – Animal and Plant Health Inspection Service (NASAC-APHIS) Aquatic Animal State list of contacts was also examined. Potential candidates for each state was called, given the objectives of the study, and asked to find the correct personnel dealing with freshwater non-game fish mortalities.

Recruitment

From the master contact list, each potential respondent was recruited by telephone. If no conversation was achieved, a voicemail was left providing information about the researcher and explaining the purpose and scope of the study. This process was repeated up to three times over several days before contacting another individual in the same department. When contact was achieved, formal introduction of the caller was provided as well as a brief description of the study. The individual was then asked if they were the correct person to respond to the survey, or if not, could provide the correct individual. This process was reiterated until the appropriate individual was identified for each state. These individuals were then asked to participate in a short web-based survey and told that they would receive an email directing them to the proper link that would only take 5-10 minutes, offered a summary of the results, and the e-mail address was confirmed.

Questionnaire Design

A copy of the questionnaire is available in Appendix B. The questionnaire was developed using the Survey Builder, a program developed and provided by North Carolina State University College of Agriculture and Life Sciences. It was composed of 17 questions. To maintain confidentiality yet make it possible to identify the questionnaire, the first question provided an area to insert a random code which was given to respondents in the email sent with link to the web-based survey.   The next three questions collected general background information regarding wild carp mortality events in the respondent's state. Questions six through 14 focused on the frequency of recording particular information in a wild carp mortality investigation.   The last set of questions were open questions that asked the respondent to summarize how non-game fish events are processed, invited thoughts regarding management or documentation of non-game freshwater fish mortality events, and solicited general comments regarding the questionnaire. A large portion of the questions were closed (three with multiple choice answers and 10 with bipolar ordinal scale answers) with predetermined categories.

A draft questionnaire was pre-tested on 11 volunteers (two in the aquatic veterinary field, two faculty and four graduate students in the NCSU Fisheries, Wildlife and Conservation Biology Program, and three from government agencies). The results and feedback received were used to adjust the questionnaire.

The final version of the questionnaire included an NCSU border, sponsorship in the title, and detailed instructions.   The detail instructions explained the objective of the study, how to answer the questions, the fact that respondents could begin the survey and return at a later time, and the confidentiality policy. The researcher's contact information and a link to the university survey policy were provided at the bottom of the survey. Once the respondent returned the survey, the screen would display an end of survey message, which thanked the respondent for their response and time.

Implementation/distribution of the Questionnaire

The mixed mode questionnaire implementation consisted of phone, email, and web-survey components. After each participant was recruited and their email address confirmed by the telephone, the questionnaire was introduced with a cover letter email providing web access details.

All emails (cover letter, reminder, and thank you) were drafted and then analyzed using spam engines, gravitymail.com and boomerang.com to reduce the risk of being targeted as spam by email security systems.

Within 24 hours of the telephone conversation, each individual recruited as a respondent was sent a personalized cover letter email from a secure university email address. The subject line included sponsorship identification and the title of the survey. The cover letter itself explained the purpose and scope of the study, asked for participation, provided a random access code, and directed the recruited respondent to the web-survey. Each state was assigned a random access code generated by using the online program, www.randomcodegenerator.nl. This allowed the researcher to keep track of who has responded and remove respondents from the reminder lists while maintaining anonymity. To encourage participation, the cover letter pointed out that the results would help assess our country's preparedness for response to unusual mortality events involving non-game freshwater fish. The cover letter also reaffirmed the brevity of the survey and stressed all individual information collected was to be kept confidential. The email was signed by unofficial personnel but with the title of Doctor of Veterinary Medicine and North Carolina State University Department title of Fisheries and Wildlife Science. As soon as a response was received, the response time was recorded, the state was removed from the reminder list, and a thank you e-mail was sent to the participant with-in 24 hours. The thank you email also reassured that a summary of results would be sent if it was requested by the respondent.

Email Procedure

The reminder emails were sent early or late in the day. If no response was received 7 days after the initial email, a reminder email with similar format was sent. The reminder email addressed the importance of their answer, confirmed the email was not lost due to spam, and resent the questionnaire.

After 14 days with no response, each participant was called by phone. The conversation made sure the emails were received, answered any questions, and if the individual needed another copy of the cover letter. If the participant was not reached, a voicemail was left with this information.

A final reminder email was sent 28 days from the initial cover letter. The final reminder had the same subject line and similar components to the primary cover letter and follow up email. This email provided the number of responses already received, mentioned how important it would be to include their state in the study, and a survey response deadline.

Tailored Protocol for Three States:

Achieving a response from three states required a slight modification to the methods. When the first reminder was sent to one state, the participant indicated they had responded to the survey. The results were not recorded by the Survey Builder. The participant was asked to re-send the results, and after a total of three attempts from the respondents and two emails and a phone call, the results were recorded by the Survey Builder. Only one reminder was recorded for this state.

In attempts to send another state's first reminder, a spam alert was received from the participant's email address. After two email attempts with the same response, the contact was left a voice mail to make sure the email was received. The participant responded to the survey the next day. Two reminders were recorded for this participant.

During phone reminders, it was discovered that one participant had not received the initial email or reminder. After several attempts with different email addresses both from the sender and the participant, a copy of the cover letter was sent by fax. A telephone reminder was done 7 days after the fax cover letter was sent. The third reminder at day 14 and final reminder at 28 days were sent by fax.

There were four respondents that were not spoken to directly. In each of these instances, someone else in the department was spoken to and the cover letter forwarded to a different respondent's email address. A voice mail regarding the study and survey was left for one state's respondent. In another instance, the appropriate correspondent was out of the office and the respondent to the survey worked in the same department.

Data Analysis

When a response was received, the time and date were recorded. Because the number of questionnaires sent varied for the first 14 days of the study, return rates (number of questionnaires received/total questionnaires) were calculated for each day of study.   The return rate was also calculated for the number of responses received for each category (after first initial email, first reminder, second phone call, and final reminder).   At the end of the study, the overall return rate was determined by calculating the number of responses received over the total number of surveys distributed.

For return time, the counted days started when the initial cover letter was sent (email 1st cover letter at day 0, 1st reminder at day 7, 2nd reminder at day 14, and final email reminder at day 28) and last day when the last response was received.

A negative binomial regression (R Program version 2.14.1, 2011 The R Foundation for Statistical Computing) was used to compare the response time for each state with the variables from the Census of Aquaculture (2005). The variables used were: total of aquaculture farms, total food fish farms, total of sport fish farms, total of ornamental fish farms, and total carp fish farms. The response time was also compared to whether each state has reported previous wild carp mortalities in the past year. This information was in reference to the respondents answer to a question on the survey "Within the past year, have there been wild carp mortalities in your state?"

A survival analysis (JMP Pro 9.2 [64-bit edition, SAS Institute Inc.]) was used to compare response time for each state compared to whether each state has a coastline (including ocean coast, golf coast, Great Lake coast). It was hypothesized that states with a coastline would respond faster. A total of 30 states have a coastline (including ocean coast, golf coast, and Great Lakes coast).

RESULTS

The overall return rate was 100% (50/50) and the completion proportion (questionnaire usable for analysis) 100% (50/50). The number of rejected surveys or non returned surveys was zero.

The return frequency for the study was at or above 50% (Figure 1). One participant took 34 days to return the questionnaire. Before the first reminder, there was a 70% response rate (35/50). Although the response rate did reach 100%, the rate for each reminder category declined from 14% to 6.0% (Table 1). When looking at the number of responses were generated by the reminders from the non-responses:: 1st email reminder (7 responses out of 15 non-respondents = 47% response rate), 2nd reminder phone call (5 respondents out of 8 non respondents = 62%), and the last reminder (3 respondents out of 3 non respondents =100%). The return pattern for all returns follows a unimodal distribution. Table 1 gives median time and range in days between date of first email and arrival of the last response. The median return time for all returns was 17 days. Before the second reminder, 84 % (42) of all returns had been received and 16% (8/50) after the phone reminder.

From the first day that a respondent was contacted to the receipt of the last survey was 35 days; this includes weekends and two government holidays, Veterans Day and Thanksgiving. The response time ranged from less than a day to 34 days. More than half of the population, 27 states, responded in less than 24 hours (Figure 2).

The completion proportion (questionnaire usable for analysis) for this study was 100% (50/50). Although two survey respondents typed an answer for one of the open questions, the answers were not applicable; therefore 37 out of the 50 states fully fulfilled the survey questions. A total of 98% (49/50) of the respondents answered all the closed ended questions and 74% (37/50) answered the open ended questions.

The number of phone calls made or received pertaining to the study was 255 and an estimate of 739 to 756 minutes. This total includes numerous calls made to reach the right respondent for each state, the voicemails left or received, and calls received from respondents. It often took one to five attempts before reaching the appropriate individual. Of the 50 states, the original contact list was correct for 24 states.

A total of 124 emails were sent and 97 were received, including 50 from the survey builder, 29 from respondents, and 18 miscellaneous emails. The 18 miscellaneous emails composed of fax confirmation and emails from the spam alert. Three individual faxes were sent to one respondent. There were a total of 28 reminders sent either by phone, email or fax.

There was no statistical evidence (p value >.05) of a relationship between the response time for each state and each state's total of aquaculture farms, total food fish farms, total of sport fish farms, total of ornamental fish farms, total carp fish farms, and reports of wild carp mortality in the past year.

There was one statistical pattern (p value <.05) identified, states with coastline responded faster to the survey. For the 50 states, 5.94 days (standard error 1.16) was the average response time. The average response time for the 30 coastline states was 4.13 days (standard error 2.27) and for the non-coastline was 8.7 days (standard error 1.13).

DISCUSSION

This study applied the tailored design method (TDM) to collect data regarding the nation's preparedness for an unusual mortality event of non-game fresh water fish. Because this study used multiple modes to contact respondents, it provided additional opportunities for tailoring the approach of survey data collection. Due to the constraint of our study population, it was not possible to have a control group or comparison study using another survey methodology. The population of focus in this study involved one individual from each state; there was no way to blind the correct respondent to the issue being surveyed. There is large variability between states with our method, and if different survey methods were used for different states, we expect variability would increase. The importance of the issue and response rate was the main reason for reducing variability.

It has been postulated that one follow up message sent about one week after the initial email invitation is optimal (Kittleson 1997) and that sending the message late in the day or early in the morning has the most effect in terms of increased response rate (Sue et al. 2007, Dillman et al. 2009). In our study this held true. Strategically sending the survey at specific times appeared to allow the respondent adequate time to process the survey and reduce the chance of it being forgotten.

The reminders were helpful for this study and may have helped achieve the 100% total return rate (Table 1). The reminders may have created a sense of guilt in terms of a desire to be viewed as cooperative and helpful. This could have especially held true when the last reminder included information regarding how many responses had been received. Although the purpose of the results summary was reward, it could have also served as tool to persuade the respondent to be viewed as cooperative, since all other states were to receive the summary.

In this study, the recruitment by telephone was done to make the study more personal, and reduce the chances for emails to be discarded or flagged as spam. The second phone call, and the second reminder, generated fewer responses than the first reminder (Figure 2). If comparing the number of respondents left, it did persuade an additional 5 respondents from the 8 non-respondents, generating by itself a response rate of 62%.

This study did have technical difficulties with the email correspondence and the survey website for a small number of participants. The protocol was tailored to overcome these challenges and achieve a response. The ability to adapt the survey methodology to include other forms of dispersing the survey facilitated this study. The phone reminder also served to double check the email tool. Faxes were sent to one participant when the initial email or reminder email was not received. A respondent was called for confirmation when it was believed a reminder was being targeted as a spam. When there was difficulty with the survey tool for a state, several attempts were made to correct the situation, and communication was maintained with the respondent until the problem was solved. If the participant was not able to send their response through the survey tool, the survey would have been completed by phone, or a hard copy of the survey was sent by fax.

The use of the mixed mode method achieved a 100% response rate in 34 days, which would normally be considered a good response. However, in an urgent situation, more than a month to gather responses may not be acceptable. The response time may have varied if the survey was a true simulation of an urgent event or if it was administered by a federal agent. The resources and effort that is put into administer a survey needs to be weighed against the urgency or importance of the data collected.

Response time can be driven by effort but effort carries associated costs. These costs are incurred by the surveyor and the respondents. When considering costs of a survey, the time required to develop the questionnaire, test the survey, and execute call back procedures are included (Fowler 2009). We recorded time spent on this study in all aspects of the construction, testing and execution of the survey and found that a large portion of the time expended was spent on phone calls (approximately 12 1/2 hours). Although there were a total of 97 email correspondences, the time required to compose each individual email was short. All cover letters, reminders, thank you emails were based on templates drafted at the start of the study. The length of the overall exercise, from the time of the first contact to the last thank you email, was 35 days which included two federal holidays, Veteran's day and Thanksgiving. This survey method required extra effort and had several challenges before the 100% response rate was achieved. To overcome some of the challenges, tailoring the design to fit for specific respondents in three states was necessary, was costly, but appeared to work. If 100% response were not a criterion of performance for the survey, the costs of this customization may not have been warranted.

The limiting factor in this study was the recruitment process. Trying to identify or contact the right person for each state was often a very time consuming process. The initial contact list was not as helpful as expected, and the apparent rapid change of responsibility at state level was problematic. Using the internet to find the correct contact was variably successful and contributed to the lengthy process. In some states a duality of responsibility complicated matters when more than one correct contact person was found resulting in several phone calls being made to resolve the question. In retrospect, it may have been a quicker to initially contact U.S. Fisheries and Wildlife regional directors for a list of state contacts for the proper respondents.

In this study the coastal states did respond faster than non-coastal states. The hypothesis that coastal states might respond more quickly to the survey was based on the potential that coastal states would have more extensively developed fisheries health programs and be better positioned to address the survey questions.

The completeness of response to the questionnaire in this study was excellent; however, only 37 out of the 50 states fully answered all survey questions. The respondents were more likely to answer the closed ended questions. The 26% of respondents that failed to answer the open ended questions may have found them to require more time or effort than they were willing to invest. The closed ended questions were more useful for obtaining information from the greatest number of respondents.

We believe that web-survey is useful and efficient for collecting additional data. Considering the complex process of survey methodology, and using tailored design methodology, this study achieved a 100% return while surveying the appropriate official from all 50 U.S. states.

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Table 2.1 Return times (in days) and response rate for emailed questionnaire on wild carp mortality event infrastructure in United States. Q1: (before the 2nd phone reminder) and Q2 (after the 2nd phone reminder). Days to respond counted from mailing day of the cover letter email with the questionnaire (email 1st cover letter at day 0, email of 1st reminder at day 7, 2nd reminder at day 14, and final email reminder at day 28).

	Return questionnaire	**Number**	**Response rate %**	**Return days**		
				Range	**Median**	
Q1	First phone call & email	35	70.0%	0-6	3	6
	First reminder email	7	14.0%	7-13	10	
Q2	Second phone call	5	10.0%	14-27	20	24
	Final reminder email	3	6.0%	28-34	32	
Total		50	100.0%	0-34	17	

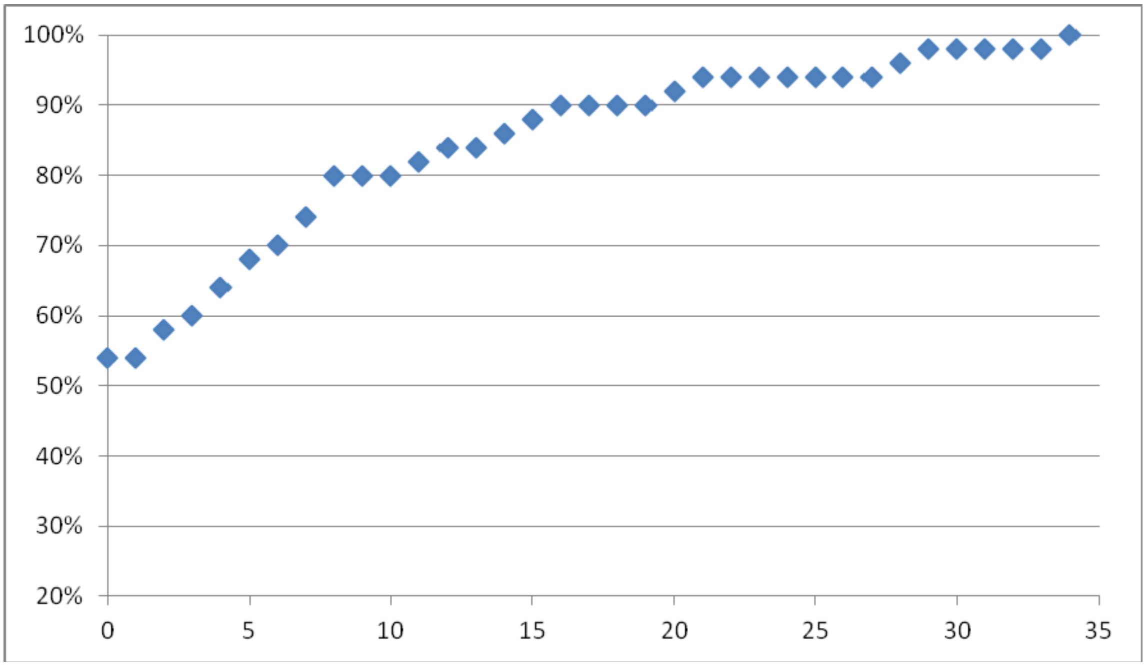

Figure 2.1 Cumulative return frequencies over time (in days) for a web survey on wild carp mortality events infrastructure. Day zero is the first day of the study when the initial email was sent and the receipt of the last response are marked as the last day of the study. Number of responses represents the cumulative returned surveys for each day of the study.

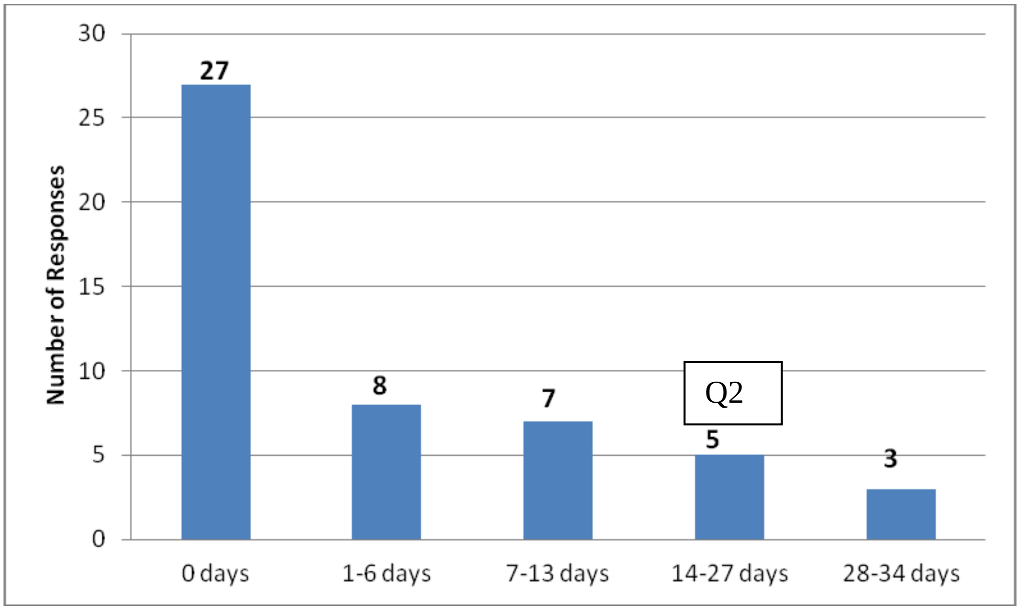

Figure 2.2 The number of responses returned over time in days for a web survey on wild carp mortality event infrastructure in the United States. The number of responses returned over time in days for a web survey on wild carp mortality event infrastructure in the United States. The Q2 marks when the second phone call (third reminder) was made and the declines of the returns.

CHAPTER 3: EVAULATION OF WILD NON-GAME FRESHWATER FISH HEALTH SURVEILANCE AND MONITORING PREPAREDNESS IN THE UNITED STATES

ABSTRACT

Mortality events in wild freshwater fish populations can be indicators of potential outbreaks that can affect wild game fish populations and the aquaculture industry. A proactive and effective surveillance system with consistent reporting, data collection and real time data analysis is needed to be aware of these mortality events. In our study, we assess the United States surveillance system for non-game freshwater fish through the use of a questionnaire evaluating current response level to wild carp mortality events in each of the 50 states of the U.S. A 100% response rate on the questionnaire was achieved, but the data obtained supports the need for significant improvement of the U.S. reporting system for non-game freshwater mortality events

INTRODCUTION

Mortality events involving non-game freshwater fish can serve as an early warning of larger events involving more economically important fish. The United States of America has already been impacted by several freshwater fish diseases. Spring Viremia of Carp (SVC), was first detected in the United States in the spring of 2002 resulting is significant population losses in Wisconsin, North Carolina and Virginia (Goodwin 2002, Dikkeboom et al. 2004).

Koi Herpes Virus (KHV) has been associated with a mass mortality event in wild common carp in the Chadakoin River, NY in 2004 (Grimmett et al. 2006). Viral Hemorrhagic Septicemia (VHS), a current emerging disease in the Great Lakes region, has caused large fish kills of variety of wild freshwater fish species (USDA 2006). These mortality events not only affect wild populations but can also impact the economics of the U.S. aquaculture industry. Outbreaks will not only economically affect the United States aquaculture industry due to loss of production but also to restriction of exportation (Perelberg et al. 2003).

In the United States the approaches to an aquatic emergency have traditionally been reactive and until recently there has been little national strategic framework to respond to aquatic disease outbreaks (Bernoth, et al. 2008). Currently in the United States, the monitoring or surveillance system is under the jurisdiction of individual states (Håstein et al. 2008). Large mortality events made the importance of coordinated emergency response, surveillance, and epidemiology studies evident. The United States, recognizing the need to improve aquatic animal health infrastructure worked in partnership with stakeholders to develop a national aquatic animal health plan developed jointly by the U.S. Department of Agriculture, Department of Commerce, and Department of Interior's Fish and Wildlife Service. The primary objective of this effort was to recommend a contingency plan for the federal government to respond to emergency situations (Håstein et al. 2008).

This descriptive study focuses on state level response to non-game freshwater fish mortality events. Wild carp were used as a model because they are nearly ubiquitous and a hardy species. A survey was used to assess how wild carp mortality events are responded to in each of the 50 U.S. states. The data returned was used to assess the United States of America's preparedness for response to unusual mortality events involving non-game freshwater fishes.

MATERIAL AND METHODS

Distribution of questionnaire and reminders

Data for this study was collected using a web based questionnaire emailed to one state fish specialist in each of the 50 U.S. states in the fall of 2010. This fish specialist was selected on the basis of being the person that dealt with non-game freshwater fish (like carp) mortality events for their state. Initial contacts were based on a pilot project that augmented and corrected a list provided by the USFWS by examining the websites of state fish and wildlife agencies, the National Association of State Aquaculture Coordinators, and the Animal and Plant Health Inspection Service (NASAC-APHIS). To identify the correct person for each state, candidates were contacted by telephone and informed about the objectives of the study and asked if they were the appropriate responder to the survey. The subsequent distribution of the questionnaire and reminders followed a protocol similar to the Dillman’s tailored design method (Dillman 2009).

Within 24 hours of the telephone conversation, a personalized cover letter email providing web access details to the survey was sent to each individual recruited as a respondent. Each respondent was identified by a randomly assigned, confidential, individual number provided in the cover letter. The first email reminder was sent 7 days following the initial cover letter if no response had been received. The second reminder, a telephone call, was implemented 14 days after sending the initial cover letter in cases where there was no response. The third and final reminder was an email sent 28 days after the initial cover letter.

Questionnaire Development

The questionnaire was comprised of 17 questions including the first question that requested the random code provided to the participant. Three questions were used to collect general background on wild carp mortality events in the respondent's state and whether records of wild carp mortality events were maintained. One question collected information on about the frequency of wild carp mortality event investigation and nine additional questions gathered information about and consistency of recording specific types of data on mortality events. Finally, a set of open questions asked the respondent to summarize how non-game fish events are processed, invited thoughts regarding management and documentation of non-game freshwater fish mortality events, and solicited general comments about the questionnaire itself.

Prior to administration, the questionnaire was pre-tested on 11 volunteers to assess clarity and evaluate time and effort required to complete the survey. The instrument was then adjusted accordingly. A copy of the questionnaire is available in Appendix B.

Data Analysis

The overall return rate was determined by calculating the number of responses received over the total number of surveys distributed. Most of the data were nominal and reported as the number of responses out of 50 or in the form of percentages.

The question asking how often reported events were investigated and particular information collected was scored using a five point scale: Never (-2), Rarely (-1), Sometimes (0), Very often (1), Always (2). If no answer was provided to a question, the state was dropped from the analysis. The question "How often reported events are investigated" was used as a validating question. Therefore any state that replied rarely or never was dropped from the scoring analysis. After each response was scored, the values of all responses were totaled to achieve a score for each state. The minimum response score possible was -20 and the maximum was 20. The response scores for each state were then combined to obtain a single aggregate response score for all 50 states with a maximum of 1000 and minimum of -1000 possible.

A linear regression (JMP Pro 9.2 [64-bit edition, SAS Institute Inc.]) was used to compare the response scores for each state with the variables from the Census of Aquaculture (2005). The variables used were: total of aquaculture farms, total food fish farms, total of sport fish farms, total of ornamental fish farms, and total carp fish farms. A Wilcoxon/Kruskal-Wallis was also used to compare response score to whether each state has reported wild carp mortalities in the past year. This information was in reference to the respondents answer to a question on the survey “Within the past year, have there been wild carp mortalities in your state?”

RESULTS

Survey Response Rate

The overall return rate for the survey study was a 100%. The response time ranged from less than a day to 34 days.

Survey Response to Closed Ended Questions

A large portion of the respondents, (49 out of 50), reported that they were the primary contact for carp mortality events in their state. The one respondent that was not, stated that multiple agencies are involved in reporting events in that state. Fifty eight percent (29/50) of the respondents reported they were certain that there had been a wild carp mortality event in their state in the past year (2009-2010). A total of 45 states responded that their agency maintains records of wild carp mortalities and respondents from 38% (19/50) of the states indicated that they always investigated reported wild carp mortality events (Table 1). Only two states reported a complete response to wild carp mortality events by always collecting geographic location, date reported, date and time of investigation, species of carp, water quality assessment, environmental parameters, fish samples, and performed fish necropsy. At least 62% (31/50) of respondents reported that their state always collected data on geographic location, date reported, date and time of investigation, and species of carp (Figure 1 and 2). In comparison only 20% (10 of 50) of respondents routinely collect water quality data and 28% (14 of 50) reported routine collection of environmental parameters respectably when investigating carp mortality events (Figure 2). Necropsy (18%, 9 of 49) and collection of fish tissues for further investigation (12%, 6 of 50) were even less commonly reported as routinely done for every reported carp mortality event (Table 1).

Survey Response to Open Questions

Respondents from 44 states volunteered a brief description of the protocol in place for their state for assessing or investigating wild carp mortality events. Although not asked directly if there was any difference between non-game and game freshwater fish investigation, 18 respondents provided this information, with 13 of 18 respondents stating there was no difference between game and non-game fish investigations in their state.   In response to a question about the best way to manage or document current and future non-game freshwater fish mortality events, a total of 37 respondents provided an opinion. Some comments from respondents included: the lack of staffing, reducing employee workload, limited communication among departments, native fish more valued then invasive fish, the lack of public reporting events because carp are viewed as nuisance fish, and the need for an agency hierarchy and national database.

Data Analysis

Numerical scores for the states ranged between -1 to 20 with a standard deviation of 5.6, and coefficient of variation of 0.53. The aggregate response score for the United States was 511 out of a maximum of 1000. The mean scores for the response to individual closed scores are presented in Table 2.

There was no statistical evidence (p value >.05) of a relationship between the response score for each state and each state's total of aquaculture farms, total food fish farms, total of sport fish farms, total of ornamental fish farms, total carp fish farms, and reports of wild carp mortality in the past year.

DISCUSSION

There are many ways to assess response readiness of states to a particular challenge. The use of a formal survey offered several advantages in this study, which looked at a closed population with access to the internet, but was geographically distributed across the United States. We expected this tool to be a low cost method that would yield quick turnaround time (Sue et al. 2007). For the study to be of value assessing the United States' preparedness to freshwater fish mortality events, it was highly desirable, if not essential, to obtain a 100% response rate to our survey. Although a 100% response rate was achieved, more time and effort was spent contacting the correct respondents and disbursing the questionnaire and reminders than we expected. Because there was not an up to date and complete contact list for each state, identifying the right respondent for the questionnaire was the most time consuming. In addition, the response time ranged from less than a day to 34 days. This may not be adequate in an emergency situation. But this study was not done in an emergency situation or indicated to the respondent that the survey was a simulation of an emergency event, therefore response time was adequate for this study.

In this study, wild carp were used as the representative model to help focus the respondents. We did not test whether this was effective, but hoped that by having a more concrete image of the relevance of the questions we were asking would minimize variability and increase compliance. The 100% response rate suggests the use of the model may have been helpful, but also suggests that it did not distract respondents from replying. The variability of the responses from state to state was greater than expected, but we believe the use of the model helped achieve a useful understanding of the true variability in approaches to response to freshwater fish mortality events across the 50 states.

The data returned in this study included indications from 29 of the 50 respondents that carp mortality events occurred in their state during 2009-2010. It is possible that this involvement of 58% of reporting states during the two year period used in the survey in carp mortality events is close to accurate because 45 of the 50 respondents also report that their state keeps records of all reported wild carp mortality events. Unfortunately only the states of 38% (19 of 50) of the respondents report they always investigate reported carp mortality events.

During the respondent recruitment process, it became evident that each state differed in how a reported carp mortality event is processed. For some states, there was no single person or department responsible for aquatic emergencies. An event could be investigated by one department or several departments depending on the potential cause of the mortality event. Often the records would then be kept by the departments that investigated the event and uniform record maintenance was lacking. In our study, there was no single attribute queried in the survey which was reported as collected by all 50 states in all investigations. One attribute, "date of investigation" approached that level of consistency. Only two states reported always collecting what the survey considered the attributes of a complete data set (geographic location, date reported, and date of investigation, species of carp, water quality assessment, environmental parameters, fish samples, and performed fish necropsy). This could potentially be challenging, particularly if a mortality event crosses political boundaries. Time would be lost in communication between states and any discord between mortality event response methods states could lead to the inability to respond appropriately to mortality events affecting non-targeted aquatic species.

Several respondents indicated the need for a more uniform approach to collection of data and record keeping. Reasons for suboptimal performance were attributed to lack of appropriate staffing, (particularly trained pathologists), lack of organization, or delay of reporting events. There were also respondents opposed to surveillance of disease in wild carp. These arguments were based on wild carp being an introduced nuisance species, with some respondents expressing indifference to carp or a perception that carp mortality events were only an issue for aquaculture and not a factor in managing wild fish health.

In addition to monitoring and reporting, the collection, processing, and analysis of data also plays a role supporting appropriate management and policy decisions (Pfeifer 2005). Uniformity data collection across states would provide better opportunity to identify key factors affecting the occurrence of freshwater fish mortality events. Inconsistent or incomplete data collection contributes to variation in the data processing and data analysis and constrains overall data quality (Pfeifer 2005). When there are compatible outbreak investigation protocols, it facilitates the integration of outbreak investigation data. Across broader geographic areas, improving the size of the useful database, and supporting increased ability to extract patterns, might guide successful prediction and mitigation of events in the future.

The major objective of this study was to assess the United States' preparedness to non-game freshwater fish mortality events.   The results of this study suggest that there is room for improvement. There is a need for public and political awareness and to promote proactive surveillance and reporting of disease in freshwater fishes. Education of the public and the government sector may improve reporting and monitoring. A coherent protocol, which includes expected minimum data collection, would better support epidemiologic and emerging disease investigations. Better uniformity of data collection, reporting, and monitoring in the United States surveillance system could significantly improve the nation's ability to respond appropriately to mortality events affecting non-game freshwater fish.

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Table 3.1 Individual survey response to questions: “How often reported wild carp mortality events are investigated?” and “How often a particular item is recorded, collected, or performed in an investigation?” *Only 49 individuals responded to this question, all other questions had 50 responses.

	Always	Very often	Sometimes	Rarely	Never	Total
How often reported events investigated?	19	21	10	0	0	50
Geographic location	34	8	7	0	1	50
Date reported	39	7	4	0	0	50
Date of investigation	40	6	4	0	0	50
Time of investigation	31	10	6	2	1	50
Species of carp	33	9	4	3	1	50
Water quality assessment	10	22	15	1	2	50
Environmental parameters	14	20	12	2	2	50
Fish necropsy*	9	2	19	17	2	49
Fish samples	6	3	26	14	1	50

Table 3.2 Distribution of individual survey response to questions: "How often reported wild carp mortality events are investigated?" and "How often a particular item is recorded, collected, or performed in an investigation?" Only 49 individuals responded to this question, all other questions had 50 responses. The average and standard deviation of response score from the 5 point scale.

	Percent of respondents				
Statement (response given on 5-point scale ranging from -3 to +3)	Always or Very often (2 or 1)	Sometimes (0)	Rarely or Never (-2 or -1)	Avg.	Standard deviation
How often reported events investigated?	80%	20%	0%	1.18	0.75
Geographic location recorded?	84%	14%	2%	1.51	0.87
Date reported recorded?	92%	8%	0%	1.69	0.62
Date of investigation recorded?	92%	8%	0%	1.71	0.61
Time of investigation recorded?	82%	12%	6%	1.37	0.99
Species of carp recorded?	84%	8%	8%	1.41	1.02
Water quality assessment recorded?	64%	30%	6%	0.73	0.95
Environmental parameters recorded?	68%	24%	8%	0.84	1.03
Fish necropsy done? *	22%	39%	39%	-0.02	1.15
Fish samples collected?	18%	52%	30%	0.00	0.96

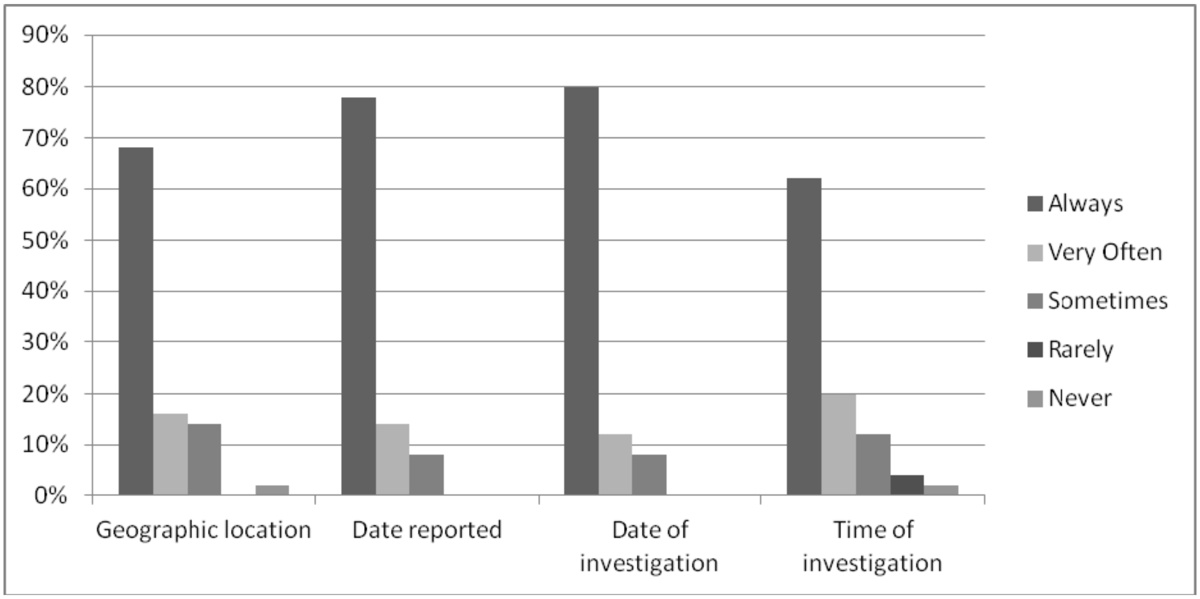

Figure 3.1 The percentage of 50 individual responses reporting how often a particular item is recorded, collected, or performed in an investigation of a wild carp mortality event

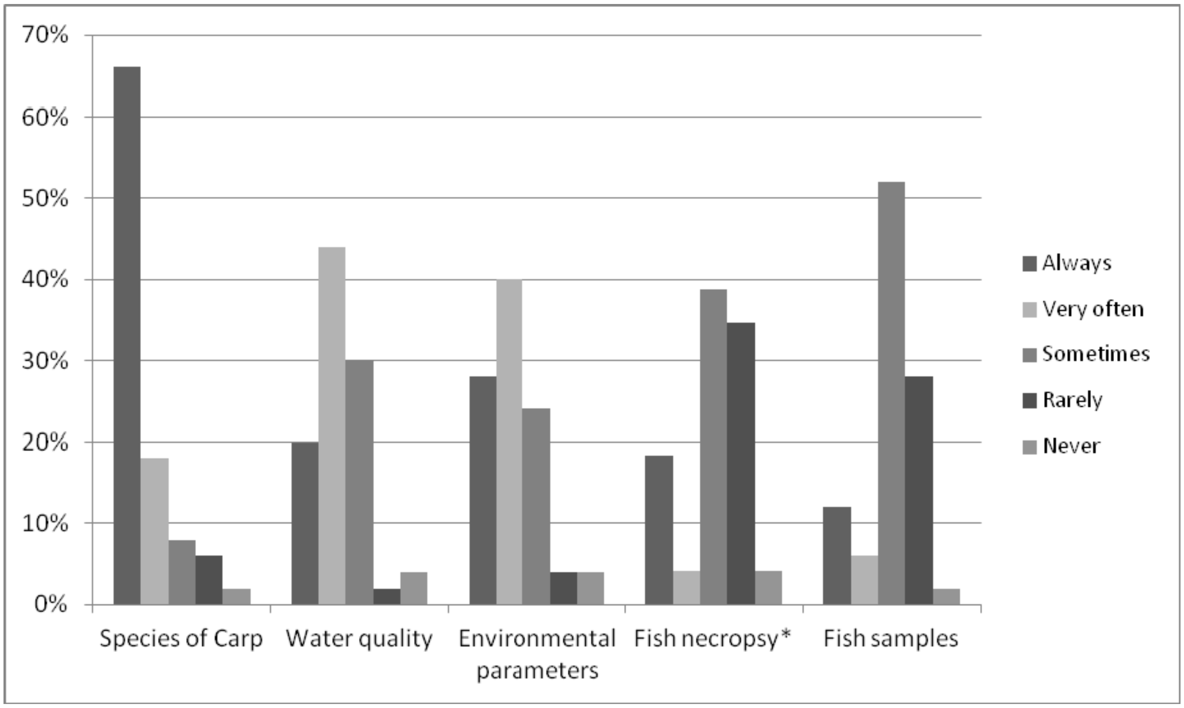

Figure 3.2 The percentage of responses reporting how often a particular item is recorded, collected, or performed in an investigation of a wild carp mortality event. *Only 49 individuals responded to the question regarding fish necropsy, all other questions were responded to by 50 individuals.

APPENDICES

Appendix A: *Pilot Study Data*

State	Year	Location	Cause
California	2005	San Joaquin River and Delta	KHV, *Flavobacterium columnare*, other mixed bacteria
Colorado	Yes, no location, cause or year provided		
Connecticut	2000	Brewster Pond	Low oxygen
	2000	Lake Pocotopaug	Asphyxiation caused by aluminum sulfate treatment
	2001	Unnamed Pond	Winterkill
	2001	Unnamed Pond	Winterkill
	2002	Connecticut River	Unknown
	2002	Private Pond	Copper sulfate treatment
	2003	Private Pond	Hypoxia
	2003	Quinebaug River	Natural
	2004	Connecticut River	Winterkill
	2004	Brewster Pond	Chemical spill
	2004	South Pond	Hypoxia
	2005	Greenwich East Lyon Condo Complex Pond	Hypoxia
	2005	Private Pond	Summerkill/spawning stress
	2005	Pope Park Pond	Chlorinated water discharge from pool
Illinois	Yes, no location, cause or year provided		
Indiana	2006	St. Joseph River	No cause provided
Iowa	2002	Cedar lake	SVCV
Kansas	Yes, no location, cause or year provided		
Louisiana	2001	False River	*Cytophaga columnaris* and Gill Flukes
	2001-02	Lake Concordia	Unknown possibly-*Cytophaga columnaris*
	2002	Poverty Point Reservoir	*Cytophaga columnaris*
	2005	Spanish Lake	*Cytophaga columnaris*
	2006	Natchitoches Parish (private pond)	Unknown
Maryland	2000	No Location Provided	Flaux bacter
	2001	No location and cause provided	
Missouri	2005	No location and cause provided	
Nebraska	2000	W. Fork of Big Blue	Suspect pesticide toxicity
	2000	Funk Lagoon	Low oxygen, high temperature due to low flow
	2000	Pawnee Reservoir backwaters	Low oxygen due to low flow

	2000	Voldemar Pond	Low oxygen due to algae die-off
	2000	Platte River	Low oxygen & high temperature due to low flow
	2000	Missouri River	Low oxygen & high temperature
	2000	Bazile Creek	Suspect low oxygen
	2000	Capital Beach	Stressed fish due to poor natural water quality
	2000	Heartwell Lake	Runoff-low dissolved oxygen due urban runoff and shallow water condition
	2001	Pawnee Park East Lake	Low oxygen
	2001	Platte River	Irrigation-thermal stress, low oxygen and stranded fish due to low flow
	2001	Pleasant Haven Pond (Bruhn Pond)	Low oxygen due to algae die-off
	2001	Odea Grove Pit	Low oxygen due to cloudy days & algae respiration
	2001	Oak Lake	Low oxygen due to cloudy days & algae respiration
	2001	Salt Creek	Suspect toxic discharge
	2001	Trib. To W, F. Big Blue River.	Suspect livestock runoff, low DO, high ammonia
	2001	Salt Creek	Suspect toxic discharge
	2001	Turkey Creek	Diesel fuel Spill
	2002	Big Papillion Creek	Ammonia toxicity-fertilizer plant ammonia spill
	2002	Pape Farm Pond	Low oxygen
	2002	Snow Lake (Private)	Low oxygen
	2002	Shurigar Pond (Private)	Physical concussion-explosive
	2002	Jurgens Pond	Low oxygen
	2002	Rezac Pond (Private)	Low water, high temperature
	2002	Wood Duck WMA (oxbow)	Low water, high temperature, low oxygen
	2002	Little Blue River	Low flow (river dry)
	2002	Foltz pond	Low oxygen
	2002	Wolf Lake (Private)	Low oxygen
	2002	Silver Creek	Suspect low flow, high temp. & low oxygen.-enhanced by livestock and municipal wastes and possible dead fish from lake renovation.
	2002	Grand Island Eagle Scout Lake	Low oxygen
	2002	Hidden Lakes (Miller Private Pond)	Low oxygen
	2002	Crescent Lake	Unknown, suspect disease/parasite or chronic WQ problem

	2003	Beaver Creek	Ammonia toxicity-York cold Storage ammonia spill
	2003	Pony Lake	Eutrification: unknown. suspect low oxygen due to algae die-off
	2003	Republican River	High temperature, low oxygen due to low flow
	2003	Harlan County Reservoir	Low water levels stranding fish in pools and Irrigation
	2003	Culbertson Canal	Low oxygen due to decomposition of organic matter washed into canal from heavy rains
	2003	Foltz Pond	Eutrification: suspect low oxygen due to shallow water and algae die-off
	2003	Elkhorn River	Agriculture livestock waste: suspect livestock waste
	2003	Platte River	Industrial-Holiday Inn domestic waste discharge
	2003	Mueller Sand Pit	Suspect natural seasonal die-off of gizzard shad
	2004	Un-Named drainage to the Platte River	Industrial-dry cleaner discharge-Naphtha mineral spirits toxicity
	2004	Big Papillion Creek	Storm water run-off: suspect urban storm water run-off
	2004	Harlan County Reservoir	Suspect high temperature & low oxygen from low flow condition
	2004	Schulyer City Park Lake	Eutrification: suspect low oxygen due to algae die-off.
	2004	Private Pond	Eutrification: suspect low oxygen due to algae die-off.
	2004	Woodward Private Pond	Eutrification: suspect low oxygen due to algae die-off.
	2004	Dawson County Drainage Ditch #4	Suspect discharge from Tenneco Automotive manufacturing plant-suspect low PH
	2004	Sutherland Reservoir	Other: excessive temperature from cooling water discharge from Gerald Gentleman Hydro-Electric Plant, high temp
	2004	Loup River	Low flow: suspect thermal stress
	2004	Loren Niemack Sandpit	Eutrification: suspect toxic algae and low oxygen due to algae die-off.
	2004	Farr Private Pond	Eutrification: suspect low oxygen due to algae die-off.
	2004	Miller Pond	Eutrification: Suspect low oxygen due to algae die-off.
	2005	Lake Helen	Suspect toxic algae bloom
	2005	Oak Creek	Significant rain event at this location and further upstream

	2005	Little Salt Creek	Likely natural due to low dissolved oxygen, heat and low water flow
	2005	West Twin lake	Suspect low dissolved oxygen due to algae bloom and low water
	2005	Loup Power Canal	Suspected low dissolved oxygen: water level had been dropped by Loup Public Power for maintenance @ Monroe dam water became stagnant in canal with overcast skies
	2005	Branched Oak Lake	Suspect low dissolved oxygen, some fish were observed at the surface earlier.
	2006	Inlet and cooling pond @ Gerald Gentleman Power Plant	Breakdown at plant resulted in drastic temperature change killing fish in the cooling pond and inlet canal-Gerald Gentleman Hydro-Electric Plant. Note: because the inlet and cooling pond are not considered waters of the state, no legal action is warranted.
	2006	Stuhr Museum Pond	Suspect viral disease
	2006	Ash Grove Lake	Thermal stress due to low water level and extreme heat.
	2006	Little Salt Creek	Suspect low oxygen
	2006	Plattsmouth City Pond	Low oxygen from algae die-off, potentially enhanced by over application of algaecide and aquatic herbicide.
	2007	Big Blue River	Suspect low oxygen under ice due to organic loading (potentially from Ag operations) and slow flow (pooled) water condition.
	2007	Tenneco Lake	Suspect low oxygen due to prolonged ice cover and shallow depth (winterkill)
New York	2004	Chadakoin River	KHV
	2005	Chautauqua Lake	KHV
North Dakota	2003/2004?	Jamestown Reservoir	unknown
	2005	Heart Butte Reservoir (Lake Tschida)	Partial oxygen deficiency
	2006	Langdon City Pond	Poor water quality
	2006	Red River	Oxygen deficiency
	2006	Heart River	poor water quality
Ohio	No year given	Rocky Fork Lake,	No cause given
	No year given	Maumee River	No cause given
	No year given	Turkey Foot Lake	No cause given

	No year given	Mosquito Lake	No cause given
Oregon	2006	Fern Ridge reservoir	low water, high temperature, low dissolved oxygen, and columnaris bacteria
South Carolina	2004	Santee-Cooper reservoir system	KHV
South Dakota	2005	Brant Lake	*Aeromonas septicemia*
Texas	2001	Prairie Creek - below spillway at Lake Tyler East near Hwy 346	Physical damage/trauma
	2002	Brady Lake	Disease-bacteria/virus (bacterial septicemia-organism?)
	2003	Colorado City Lake public boat ramp	Biotoxin-algal bloom
	2003	Lake Ray Hubbard - Dallas, Tx.	Low dissolved oxygen
	2003	Lake Ray Hubbard - Dallas, Tx.	Temperature
	2004	Between Glen Lakes Blvd and Lake Olympia	Temperature
	2006	Twin Buttes Reservoir - along Middle Concho River Arm	Disease-*Flavobacterium columnare* and koi herpesvirus
	2006	Clear Fork of Trinity River - FM730 bridge pool	Low dissolved oxygen
	2006	Lake Mackenzie	Disease-unknown/undetermined
Wyoming	2001	Glendo Reservoir	Cause of death: undetermined
	2002	Lodgepole Creek	Low water flow-suspected anoxia

Appendix B: *Questionnaire*

NC STATE UNIVERSITY | 125 YEARS   CAMPUS DIRECTORY | LIBRARIES | MYPACK PORTAL | CAMPUS MAP | SEARCH NCSU.I

click for mobile version

North Carolina State University Survey on Wild Carp Mortality Events Infrastructure

Thank you for taking the time to complete this important questionnaire. All questions pertain to wild fish kills involving carp. Your inputs are greatly appreciated. At the end of the survey, a field will be provided for comments if you would like to expand on your responses to the questions below. You may begin or restart the survey at any time, but answers are only saved once the survey is submitted. Your response to the survey will be used in accordance with North Carolina State University Research Policies. All data will be identified and reported by state.

1. Please insert your code provided in the e-mail:

2. To your knowledge, is your institution/agency the primary contact for reporting wild carp mortality events in your state?

- ○ Yes (Proceed with the rest of the survey)
- ○ Don't know
- ○ No, please indicate the agency that is the primary contact:

3. Within the past year, has there been a wild carp mortality event in your state?

- ○ Yes
- ○ No
- ○ Don't know

4. Does your institution/agency keep records of wild carp mortalities?

- ○ Yes
- ○ No
- ○ Don't know

5. When wild carp mortality events are reported approximately how often are they investigated?

- ○ Always
- ○ Very often
- ○ Sometimes
- ○ Rarely
- ○ Never

How often in wild carp mortality investigation, is the following information recorded?	Always	Very often	Sometimes	Rarely	Never
6. Geographic location (GPS, GIS coordinates, body of water)	○	○	○	○	○
7. Date reported	○	○	○	○	○
8. Date of investigation	○	○	○	○	○
9. Time of investigation	○	○	○	○	○
10. Species of carp involved	○	○	○	○	○
11. Water quality assessment	○	○	○	○	○
12. Environmental parameters (weather, air temperature)	○	○	○	○	○

13. When investigating a wild carp mortality event, approximately how often is a fish necropsy preformed?

- ○Always
- ○Very often
- ○Sometimes
- ○Rarely
- ○Never

14. When investigating a wild carp mortality event, approximately how often are fish samples of any variety collected?

- ○Always
- ○Very often
- ○Sometimes
- ○Rarely
- ○Never

15. Please provide a brief description that summarizes how most non-game fish mortality events are processed?

16. Please provide any thoughts concerning the best way to manage or document current and future non-game freshwater fish mortality events:

17. Any comments related to any of the above questions is appreciated:

You are about to submit results for the following survey/test:

North Carolina State University Survey on Wild Carp Mortality Events Infrastructure

If this is correct, click the 'Submit' button below.

Submit

Please contact the owner, meserran@ncsu.edu, of this survey if you have any questions or comments.

If you need to report a technical problem with this site, please email cals_webapp@ncsu.edu
Help desk hours: M-F, 8 am - 5 pm EST

Contact Us Privacy University Policies

Appendix C*: Email Templates*

First Cover letter email

Subject: Wild Carp Survey by North Carolina State University
Dear

Thank you for taking the time to talk to me today and for agreeing to take this short 17 question survey and that should take no more than 10 minutes to complete.

The survey pertains to our study focused on the response to non-game freshwater fish mortality events. We are using wild carp as widely dispersed model assessing several questions. An objective of the study is to look at what information is available on a state by state basis related to non-game freshwater fish mortality, using carp as a model. And ultimately assess our country's preparedness for response to unusual mortality events involving non-game fresh water fishes.

Please click on the link below to access the brief survey website (or copy and paste the survey link into your internet browser) and enter the personal access code as the first entry of survey to maintain personal anonymity. You may begin or restart the survey at any time, but answers are only saved once the survey is submitted.

Survey Link: http://harvest.cals.ncsu.edu/surveybuilder/form.cfm?testid=8151
(If there are any problems with the link or accessing the survey, please contact me)

Personal Access Code: XXXX

Your participation in this survey is voluntary and all your responses will be managed carefully according with North Carolina State University Research Policy. The access code is used to remove the state from our list once survey is completed. All data will be aggregated and reported by state so that individual information and outbreaks are kept confidential.

If you have any questions or comments about this study, please feel free to contact me at meserran@ncsu.edu or 919-290-3409 or 978-660-9460 (c).

We appreciate your time and consideration in completing the survey. Your response to this survey is very important and helps with assessing United States monitoring system of mortality events of non-game freshwater fish.
Sincerely,

First Reminder email

Subject: Wild Carp Survey by North Carolina State University
Dear ,

We understand how valuable your spare time is and it is possible my first e-mail with the survey link did not make it or it was tagged as spam mail. Your response is very important for efforts to assess the national preparedness for response to freshwater non-game fish mortality events. The survey does not ask for specific data and questions are easily answered.

The survey pertains to our study focused on the response to non-game freshwater fish mortality events. We are using wild carp as widely dispersed model assessing several questions. An objective of the study is to look at what information is available on a state by state basis related to non-game freshwater fish mortality, using carp as a model. And ultimately assess our country's preparedness for response to unusual mortality events involving non-game fresh water fishes.

This is a short 17 question confidential survey and should take you no more than ten minutes to complete. Please click on the link below to access the brief survey website (or copy and paste the survey link into your internet browser) and enter the personal access code as the first entry of survey to maintain personal anonymity. You may begin or restart the survey at any time, but answers are only saved once the survey is submitted.

Survey Link: http://harvest.cals.ncsu.edu/surveybuilder/form.cfm?testid=8151
(If there are any problems with the link or accessing the survey, please contact me)

Personal Access Code:

Your participation in this survey is voluntary and all your responses will be managed carefully according with North Carolina State University Research Policy. The access code is used to remove the state from our list once survey is completed. All data will be aggregated and reported by state so that individual information and outbreaks are kept confidential.

Your response to this survey will be very important and help with assessing United States monitoring system of mortality events of non-game fish like carp. Thank you for your help by completing the survey.

Sincerely,

Final Reminder cover letter email

Subject: Wild Carp Survey by North Carolina State University

Dear

We understand how valuable your spare time is and wanted to make sure that xxx is represented in our study. We have received responses from 47 states but xxx is still not represented. This is our last reminder e-mail because unfortunately, our study can't keep the survey open, so the survey will be closed for further responses by the end of the business day of Dec xth. We think xxx needs to be represented in this study.

Please click on the link below to access the brief survey website (or copy and paste the survey link into your internet browser) and enter the personal access code as the first entry of survey to maintain personal anonymity. You may begin or restart the survey at any time, but answers are only saved once the survey is submitted.

Survey Link: http://harvest.cals.ncsu.edu/surveybuilder/form.cfm?testid=8151
(If there are any problems with the link or accessing the survey, please contact me)

Personal Access Code: XXXX

Your participation in this survey is voluntary and all your responses will be managed carefully according with North Carolina State University Research Policy. The access code is used to remove the state from our list once survey is completed. All data will be aggregated and reported by state so that individual information and outbreaks are kept confidential.

Your response to this survey will be very important and help with assessing United States monitoring system of mortality events of non-game fish like carp. Thank you for your help by completing the survey.

Sincerely,

Thank you email

Subject: Thank you for your response to the Wild Carp Survey by North Carolina State University
Dear

Thank you for your prompt response to the survey. Your response will be of great value to further develop the monitoring system for wild non-game fish health issues in United States. I appreciate your time and your help with my master's study.

If you were interested in a copy of the summary results, I will send a copy as soon as the results are compiled and analyzed. If you have changed your mind, please feel free to contact me.

Thank you,

Appendix D: *Response Data*

(ID, date the survey sent, date response received, reminders); to maintain confidentiality respondents identified by random code different to that of the survey)

Notes:
S94W8* (*Although 1 reminder email was sent, respondent stated that they already had responded, took 3 attempts (2 email, 1 phone call to confirm taking of survey) before response registered)

6LKPP** (**Sent original email, reminder email, and phone call reminder. On phone reminder, it was realized email was not getting through. Original email was sent by fax, phone call was next reminder, then second reminder email by fax, and final reminder by fax. Included in reminder calculation is all but the original email and fax copy of original email. Potential corrected calculated response time would be from when the first fax sent and that was on 11/19/2010 at 1:11 pm so corrected response time would be 18 days.)

PFRHB*** (*** The 1st reminder email and phone call was at the same time.)

Respondent random ID	Date survey sent (2010)	Time survey sent (Eastern)	Date response (2010)	Time survey received (Eastern)	Response time (days)	Reminders
JHKGF	5-Nov	9:50 AM	9-Nov	10:02 AM	4	0
YZSFP	3-Nov	7:50 PM	4-Nov	7:50 PM	<1	0
M4ABR	3-Nov	5:59 PM	8-Nov	12:33 PM	4.5	0
Y4CCC	5-Nov	10:53 AM	3-Dec	12:40 PM	28	3
NVGCK	10-Nov	2:31 PM	10-Nov	3:22 PM	<1	0
6T4ED	10-Nov	12:41 PM	11-Nov	11:39 AM	<1	0
X4WA9	2-Nov	2:18 PM	9-Nov	11:27 AM	7	1
JE3Z9	3-Nov	11:47 AM	3-Nov	1:31 PM	<1	0
SMCHQ	8-Nov	3:50 PM	8-Nov	4:23 PM	<1	0
QE2LG	2-Nov	11:57 AM	1-Dec	10:41 AM	29	3
R3FD9	3-Nov	8:11 PM	4-Nov	4:16 PM	<1	0
MMKAM	3-Nov	6:23 PM	3-Nov	6:42 PM	<1	0
DQ6B6	3-Nov	3:18 PM	4-Nov	10:07 AM	<1	0
2AS7T	3-Nov	12:28 PM	3-Nov	1:11 PM	<1	0
FYXZB	3-Nov	2:25 PM	3-Nov	3:42 PM	<1	0
S94W8*	15-Nov	2:31 PM	29-Nov	2:42 PM	14	1

EQ6Q2	5-Nov	10:29 AM	5-Nov	12:13 PM	<1	0
6UUUV	10-Nov	9:46 AM	10-Nov	10:28 AM	<1	0
V2GKW	8-Nov	10:31 AM	12-Nov	12:23 PM	4.5	0
G2V8C	5-Nov	12:32 PM	16-Nov	3:07 PM	11.5	1
A6XZL	3-Nov	4:36 PM	4-Nov	9:04 AM	<1	0
4AHAZ	9-Nov	8:03 AM	9-Nov	8:24 AM	<1	0
J96EM	5-Nov	11:27 AM	5-Nov	12:23 PM	<1	0
KML43	8-Nov	9:45 AM	8-Nov	10:39 AM	<1	0
NTHN7	10-Nov	10:41 AM	17-Nov	1:53 PM	7	1
J7PLN	5-Nov	1:12 PM	8-Nov	12:46 PM	3	0
TEJRG	3-Nov	3:43 PM	5-Nov	10:00 AM	1.5	0
MBWQQ	3-Nov	7:03 PM	9-Nov	9:00 PM	6	0
FDW4C	9-Nov	1:09 PM	9-Nov	8:30 PM	<1	0
GRCTN	5-Nov	9:14 AM	12-Nov	3:15 PM	7.5	1
6LKPP**	3-Nov	6:33 PM	7-Dec	1:40 PM	33.5	5
J4KCG	2-Nov	10:50 AM	2-Nov	11:14 AM	<1	0
4447J	5-Nov	9:31 AM	5-Nov	12:07 PM	<1	0
A84TR	5-Nov	12:49 PM	5-Nov	6:03 PM	<1	0
PFRHB***	16-Nov	8:31 AM	24-Nov	11:24 AM	8	2
BRV2R	8-Nov	9:54 AM	23-Nov	10:39 AM	15	2
TTW3Y	5-Nov	1:36 PM	5-Nov	1:54 PM	<1	0
D563C	8-Nov	5:00 PM	8-Nov	5:15 PM	<1	0
6KM82	5-Nov	11:57 AM	21-Nov	3:12 PM	16	2
2DQG2	2-Nov	5:02 PM	2-Nov	5:48 PM	<1	0
XA57E	10-Nov	11:16 AM	12-Nov	9:50 AM	2	0
YQH24	8-Nov	12:34 PM	16-Nov	9:36 AM	8	1
3X4CW	3-Nov	5:00 PM	3-Nov	5:09 PM	<1	0
682DZ	8-Nov	5:45 PM	8-Nov	6:54 PM	<1	0
DEQMR	3-Nov	10:34 AM	24-Nov	10:58 AM	21	2
T2H3M	8-Nov	9:27 AM	8-Nov	4:32 PM	<1	0
QFMBR	4-Nov	7:15 PM	8-Nov	12:47 PM	3.5	0
B3R76	5-Nov	11:55 AM	5-Nov	1:06 PM	<1	0
X8X3L	5-Nov	2:55 PM	16-Nov	2:10 PM	11	1
8VT5G	9-Nov	1:07 PM	29-Nov	11:26 AM	20	2

Appendix E*: Phone Data*

(To maintain confidentiality respondents identified by random code different to that of the survey)

Respondent random ID	Date (2010)	Time	Minutes	Total min estimated	Total min without estimate
JHKGF					
	2-Nov	4:00 PM	5		
	3-Nov	9:31 AM	7		
	3-Nov	10:46 AM	4		
	5-Nov	9:34 AM	4		
				20	20
YZSFP					
	3-Nov	7:39 PM	3		
				3	3
M4ABR					
	3-Nov	5:24 PM	4		
	3-Nov	5:31 PM	3		
				7	7
Y4CCC					
	3-Nov	11:04 AM	5		
	5-Nov	10:35 AM	3		
	19-Nov	9:37 AM	estimate 1-2 min		
				9-10	8
NVGCK					
	3-Nov	7:09 PM	2		
	5-Nov	1:39 PM	2		
	8-Nov	5:13 PM	2		
	10-Nov	11:24 AM	2		
	10-Nov	11:35 AM	2		
	10-Nov	11:40 AM	5		
	10-Nov	2:15 PM	7		

	10-Nov	3:23 PM	12		
	15-Nov	10:29 AM	2		
				36	36
6T4ED					
	3-Nov	5:44 PM	2		
	5-Nov	12:54 PM	3		
	8-Nov	4:51 PM	1		
	8-Nov	5:18 PM	3		
	10-Nov	11:21 AM	2		
	10-Nov	11:26 AM	2		
	10-Nov	12:29 PM	3		
				16	16
X4WA9					
	2-Nov	9:39 AM	1		
	2-Nov	9:43 AM	1		
	2-Nov	2:02 PM	2		
	2-Nov	2:04 PM	3		
				7	7
JE3Z9					
	3-Nov	11:19 AM	3		
	3-Nov	11:40 AM	3		
				6	6
SMCHQ					
	2-Nov	3:36 PM	5		
	8-Nov	9:57 AM	2		
	8-Nov	3:02 PM	1		
	8-Nov	3:06 PM	1		
	8-Nov	3:39 PM	4		
				13	13
QE2LG					
	2-Nov	10:01 AM	1		
	2-Nov	10:05 AM	4		
	2-Nov	11:37 AM	3		
	2-Nov	11:48 AM	4		
	16-Nov	8:40 AM	estimate 3-7 min		

				15-19	12
R3FD9					
	3-Nov	7:52 PM	4		
				4	4
MMKAM					
	3-Nov	6:11 PM	5		
				5	5
DQ6B6					
	3-Nov	11:12 AM	3		
	3-Nov	2:40 PM	8		
				11	11
2AS7T					
	2-Nov	3:43 PM	3		
	3-Nov	11:26 AM	4		
	3-Nov	11:36 AM	2		
	3-Nov	12:02 PM	3		
	3-Nov	12:14 PM	4		
	3-Nov	12:33 PM	5		
				21	21
FYXZB					
	3-Nov	11:16 AM	2		
	3-Nov	12:31 PM	2		
	3-Nov	2:14 PM	4		
				8	8
S94W8*					
	3-Nov	3:29 PM	3		
	5-Nov	12:19 PM	2		
	8-Nov	9:48 AM	1		
	8-Nov	10:15 AM	2		
	9-Nov	12:43 PM	2		
	9-Nov	12:46 PM	2		
	10-Nov	9:23 AM	4		
	15-Nov	12:00 PM	1		
	15-Nov	1:00 PM	estimate 1 min		

	15-Nov	2:20 PM	estimate 2-3 min		
	15-Nov	2:27 PM	estimate 3 min		
	29-Nov	12:48 PM	2		
				25-26	19
EQ6Q2					
	2-Nov	3:53 PM	2		
	2-Nov	3:55 PM	3		
	3-Nov	10:51 AM	3		
	5-Nov	10:24 AM	3		
				11	11
6UUUV					
	3-Nov	11:52 AM	4		
	5-Nov	11:01 AM	2		
	8-Nov	9:30 AM	2		
	8-Nov	9:34 AM	1		
	9-Nov	12:29 PM	3		
	10-Nov	9:20 AM	2		
	10-Nov	9:30 AM	4		
	10-Nov	9:35 AM	3		
				21	21
V2GKW					
	2-Nov	10:19 AM	1		
	2-Nov	2:23 PM	2		
	5-Nov	8:53 AM	1		
	5-Nov	9:54 AM	2		
	5-Nov	1:57 PM	2		
	8-Nov	10:21 AM	6		
				14	14
G2V8C					
	2-Nov	10:24 AM	1		
	2-Nov	2:26 PM	6		
	5-Nov	8:56 AM	4		
	5-Nov	12:25 PM	3		
				14	14

A6XZL					
	2-Nov	10:31 AM	3		
	2-Nov	2:32 PM	6		
	3-Nov	4:15 PM	4		
				13	13
4AHAZ					
	2-Nov	3:47 PM	3		
	8-Nov	9:55 AM	1		
	8-Nov	3:37 PM	2		
	8-Nov	4:00 PM	1		
	8-Nov	4:08 PM	2		
				9	9
J96EM					
	3-Nov	11:59 AM	3		
	5-Nov	11:04 AM	4		
	5-Nov	11:13 AM	4		
				11	11
KML43					
	3-Nov	12:45 PM	2		
	5-Nov	11:29 AM	2		
	5-Nov	11:35 AM	5		
	5-Nov	12:00 PM	2		
	8-Nov	9:38 AM	3		
				14	14
NTHN7					
	3-Nov	2:05 PM	1		
	3-Nov	2:07 PM	2		
	3-Nov	2:34 PM	3		
	5-Nov	10:04 AM	4		
	5-Nov	11:58 AM	2		
	8-Nov	10:00 AM	3		
	8-Nov	10:07 AM	5		
	9-Nov	12:50 PM	1		
	10-Nov	9:17 AM	2		
	10-Nov	10:14 AM	4		
	10-Nov	10:20 AM	6		

				33	33
J7PLN					
	3-Nov	5:48 PM	3		
	4-Nov	6:29 PM	2		
	5-Nov	12:58 PM	5		
				10	10
TEJRG					
	3-Nov	3:35 PM	3		
				3	3
MBWQQ					
	3-Nov	6:48 PM	4		
				4	4
FDW4C					
	2-Nov	10:36 AM	1		
	2-Nov	2:39 PM	6		
	5-Nov	9:01 AM	3		
	8-Nov	10:34 AM	1		
	8-Nov	10:35 AM	5		
	9-Nov	1:01 PM	4		
				20	20
GRCTN	2-Nov	10:37 AM	1		
	2-Nov	2:49 PM	1		
	2-Nov	2:50 PM	1		
	5-Nov	9:05 AM	1		
	5-Nov	9:06 AM	4		
				8	8
6LKPP					
	3-Nov	5:54 PM	2		
	3-Nov	6:24 PM	3		
	17-Nov	10:23 AM	estimate 1-2 min		
	17-Nov	11:13 AM	3		
	17-Nov	11:28 AM	1		
	17-Nov	11:30 AM	2		
	18-Nov		estimate 1-2 min		

	19-Nov	10:10 AM	estimate 2-3 min		
	19-Nov	10:26 AM	1		
	19-Nov	11:03 AM	1		
	19-Nov	11:05 AM	1		
	19-Nov	12:32 PM	7		
	19-Nov	1:01 PM	2		
	19-Nov	1:21 PM	1		
	23-Nov	10:45	2		
	29-Nov	1:02 PM	2		
				32-35	28
J4KCG	2-Nov	10:42 AM	5		
				5	5
4447J					
	2-Nov	10:54 AM	1		
	2-Nov	2:52 PM	3		
	2-Nov	2:56 PM	1		
	2-Nov	4:33 PM	7		
	3-Nov	1:47 PM	5		
	3-Nov	1:55 PM	5		
	5-Nov	9:22 AM	3		
				25	25
A84TR					
	3-Nov	3:59 PM	3		
	5-Nov	12:43 PM	3		
				6	6
PFRHB					
	2-Nov	11:09 AM	1		
	2-Nov	3:01 PM	2		
	5-Nov	9:17 AM	3		
	5-Nov	1:55 PM	1		
	9-Nov	12:35 PM	3		
	9-Nov	12:37 PM	2		
	16-Nov	8:26 AM	estimate 3 min		
	23-Nov	10:21 PM	4		

				19	16
BRV2R					
	3-Nov	2:38 PM	2		
	8-Nov	9:50 AM	2		
	23-Nov	10:27 AM	2		
				6	6
TTW3Y					
	3-Nov	7:05 PM	2		
	4-Nov	7:01 PM	1		
	5-Nov	1:24 PM	6		
				9	9
D563C	2-Nov	11:20 AM	4		
	5-Nov	9:52 AM	1		
	8-Nov	8:52 AM	5		
	8-Nov	3:30P	3		
	8-Nov	4:52 PM	4		
				17	17
6KM82					
	3-Nov	10:37 AM	3		
	5-Nov	9:58 AM	4		
	19-Nov	8:40 AM	estimate 1-2 min		
				8-9 min	7
2DQG2					
	2-Nov	3:07 PM	4		
	2-Nov	4:46 PM	5		
				9	9
XA57E					
	3-Nov	5:20 PM	2		
	5-Nov	12:51 PM	2		
	8-Nov	3:54 PM	4		
	8-Nov	4:01 PM	7		
	9-Nov	12:52 PM	1		
	10-Nov	10:54 AM	4		
	10-Nov	11:07 AM	2		
				22	22
YQH24					

	2-Nov	4:17 PM	5		
	5-Nov	10:31 AM	2		
	8-Nov	11:40 AM	4		
				11	11
3X4CW					
	3-Nov	4:08 PM	1		
	3-Nov	4:09 PM	3		
	3-Nov	4:26 PM	7		
	3-Nov	4:49 PM	4		
				15	15
682DZ					
	3-Nov	6:00 PM	4		
	5-Nov	1:16 PM	2		
	8-Nov	5:05 PM	2		
	8-Nov	5:17 PM	1		
	8-Nov	5:35 PM	5		
				14	14
DEQMR					
	2-Nov	3:12 PM	1		
	3-Nov	10:20 AM	4		
	17-Nov	10:29 AM	estimate 3-7 min		
				8-12 min	5
T2H3M					
	2-Nov	3:16 PM	4		
	3-Nov	10:17 AM	3		
	5-Nov	10:11 AM	2		
	5-Nov	2:11 PM	10		
	5-Nov	2:22 PM	1		
	5-Nov	2:23 PM	10		
	8-Nov	8:58 AM	10		
				40	40
QFMBR					
	3-Nov	7:12 PM	2		
	4-Nov	7:02 PM	5		
				7	7

B3R76					
	2-Nov	3:31 PM	2		
	5-Nov	10:16 AM	4		
	5-Nov	11:40 AM	6		
				12	12
X8X3L					
	3-Nov	3:21 PM	4		
	5-Nov	12:04 PM	4		
	5-Nov	2:41 PM	4		
				12	12
8VT5G					
	3-Nov	6:04 PM	1		
	3-Nov	6:05 PM	4		
	5-Nov	1:19 PM	2		
	5-Nov	1:22 PM	1		
	5-Nov	1:30 PM	1		
	8-Nov	5:08 PM	2		
	9-Nov	12:55 PM	4		
	15-Nov		estimate 1-2 min		
	17-Nov	10:09 AM	estimate 1-2 min		
	17-Nov	10:12 AM	estimate 1-2 min		
	23-Nov	10:33 AM	2		
				20-23 min	19
Unknown Identity	8-Nov	10:54 AM	1		
Unknown Identity	8-Nov	5:19 PM	3		
				4	4

Voicemail		
Date (2010)	Time (Eastern)	Minutes
3-Nov	12:02 PM	4
3-Nov	12:11 PM	1
3-Nov	12:12 PM	2
3-Nov	2:10 PM	1
3-Nov	2:11 PM	1
4-Nov	5:46 PM	4
4-Nov	6:24 PM	4
4-Nov	6:42 PM	6
5-Nov	8:49 AM	1
5-Nov	1:04 PM	1
5-Nov	2:00 PM	3
8-Nov	11:38 AM	2
8-Nov	1:33 PM	1
8-Nov	2:56 PM	2
8-Nov	2:59 PM	1
8-Nov	3:58 PM	1
9-Nov	12:11 PM	2
9-Nov	12:31 PM	1
9-Nov	12:32 PM	3
9-Nov	5:29 PM	2
9-Nov	10:36 PM	2
Total		45

Total number of minutes before estimates	Minimum minutes estimated	Maximum minutes estimated	Range of minutes
715	24	41	739-756
Total number of phone calls (unknown, voicemail, for each state)			
255			

Appendix F: *Overall Response Rate*

Date (2010)	Number of survey sent	Total survey sent	Number of responses received that day	Cumulative total response received	Response rate for each date (total response/total survey sent)
2-Nov	4	4	2	2	50%
3-Nov	14	18	5	7	39%
4-Nov	1	19	4	11	58%
5-Nov	13	32	7	18	56%
8-Nov	8	40	8	26	65%
9-Nov	3	43	5	31	72%
10-Nov	5	48	2	33	69%
11-Nov	0	48	1	34	71%
12-Nov	0	48	3	37	77%
15-Nov	1	49	0	37	76%
16-Nov	1	50	3	40	80%
17-Nov	0	50	1	41	82%
21-Nov	0	50	1	42	84%
23-Nov	0	50	1	43	86%
24-Nov	0	50	2	45	90%
29-Nov	0	50	2	47	94%
1-Dec	0	50	1	48	96%
3-Dec	0	50	1	49	98%
7-Dec	0	50	1	50	100%

Response rate used for chapter 2

Response time (days)	Number responses returned	Cumulative number of responses returned	Cumulative returned rate
0	27		54%
1	0	27	54%
2	2	29	58%
3	1	30	60%
4	2	32	64%
5	2	34	68%
6	1	35	70%
7	2	37	74%
8	3	40	80%
9	0	40	80%
10	0	40	80%
11	1	41	82%
12	1	42	84%
13	0	42	84%
14	1	43	86%
15	1	44	88%
16	1	45	90%
17	0	45	90%
18	0	45	90%
19	0	45	90%
20	1	46	92%
21	1	47	94%
22	0	47	94%
23	0	47	94%
24	0	47	94%
25	0	47	94%
26	0	47	94%
27	0	47	94%
28	1	48	96%
29	1	49	98%
30	0	49	98%

31	0	49	98%
32	0	49	98%
33	0	49	98%
34	1	50	100%

Appendix G: *Completeness of Questionnaire*

Number or responses answered or not (to maintain confidentiality respondents identified by random code different to that of the survey)

Respondent random ID	Answered all closed questions	Answered all open questions excluding comment question	All questions answered excluding 17	Notes
JHKGF	y	n*	n*	*not valid question for #16 because answered: "N/A"
YZSFP	y	y	y	
M4ABR	y	Didn't answer #16	n	
Y4CCC	y	y	y	
NVGCK	y	y	y	
6T4ED	y	y	y	
X4WA9	y	y	y	
JE3Z9	y	Didn't answer #16	n	
SMCHQ	y	y	y	
QE2LG	y	y	y	
R3FD9	y	y	y	
MMKAM	y	y	y	
DQ6B6	y	y	y	
2AS7T	y	y	y	
FYXZB	y	y	y	
S94W8	y	y	y	
EQ6Q2	y	Didn't answer # 16	n	
6UUUV	y	n*	n*	*not valid question for #16 because answered: "none at this time"

V2GKW	y	y	y	
G2V8C	y	y	y	
A6XZL	y	y	y	
4AHAZ	y	y	y	
J96EM	y	y	y	
KML43	y	y	y	
NTHN7	y	y	y	
J7PLN	y	Didn't answer #16	n	
TEJRG	y	y	y	
MBWQQ	y	y	y	
FDW4C	y	y	y	
GRCTN	y	y	y	
6LKPP	y	Didn't answer #16	n	
J4KCG	y	y	y	
4447J	y	y	y	
A84TR	y	Didn't answer #16	n	
PFRHB	y	y	y	
BRV2R	n*	Didn't answer #16	n	Didn't answer #13, question on Fish Necropsy
TTW3Y	y	y	y	
D563C	y	y	y	
6KM82	y	y	y	
2DQG2	y	y	y	
XA57E	y	y	y	
YQH24	y	y	y	
3X4CW	y	Didn't answer #16	n	
682DZ	y	y	y	
DEQMR	y	y	y	
T2H3M	y	Didn't answer #16	n	
QFMBR	y	Didn't answer # 16	n	
B3R76	y	y	y	
X8X3L	y	Didn't answer #16	n	
8VT5G	y	y	y	
Total did answer	49	37	37	

Total did not answer	1	13	13	

Appendix H: *Response to Closed Ended Questions*

Y= yes, N= no;
Q2: Is their institution/agency the primary contact for reporting wild carp mortality events?
(yes, don't know, No (indicated the agency that is the primary contact)
Q3: A wild carp mortality event in the past year?
Q4: Institution/agency keeps records of wild carp mortalities?
Q5: How often reported events investigated? (Always, Very often, Sometimes, Rarely, Never)
Questions 6-14, pertain to how often particular information is collected in an investigation of a wild carp mortality event (Always, Very often, Sometimes, Rarely, Never)
(to maintain confidentiality respondents identified by random code different to that of the survey)

Notes: * Although recipient answered No, they indicated that another department is also involved

Respondent random ID	Q2	Q3	Q4	Q5	Location	Date reported	Date of investigation
JHKGF	y	y	y	always	always	always	always
YZSFP	y	n	y	sometimes	sometimes	sometimes	sometimes
M4ABR	y	n	y	always	always	always	always
Y4CCC	y	y	y	very often	very often	always	Always
NVGCK	y	y	y	always	always	very often	very often
6T4ED	y	y	y	very often	always	always	always
X4WA9	y	n	y	always	always	always	always
JE3Z9	y	y	y	always	always	always	always
SMCHQ	y	n	n	sometimes	very often	very often	very often
QE2LG	y	n	y	always	always	always	always
R3FD9	y	n	y	always	never	always	always
MMKAM	y	n	n	always	very often	very often	very often
DQ6B6	y	y	y	always	sometimes	always	always
2AS7T	y	y	y	sometimes	sometimes	sometimes	sometimes
FYXZB	y	y	y	very often	sometimes	very often	always
S94W8	y	y	y	very often	very often	always	always
EQ6Q2	y	y	y	always	always	always	always
6UUUV	y	y	y	very often	very often	always	always
V2GKW	y	n	y	very often	always	always	always
G2V8C	y	n	y	very often	always	always	always
A6XZL	y	y	y	sometimes	always	always	always
4AHAZ	y	n	y	always	always	always	always

J96EM	y	y	y	sometimes	always	always	always
KML43	y	y	y	always	always	always	always
NTHN7	y	y	y	very often	always	always	always
J7PLN	y	n	y	very often	always	always	always
TEJRG	y	y	y	very often	always	always	always
MBWQQ	n*	y	n	always	always	always	always
FDW4C	y	don't know	n	sometimes	always	always	always
GRCTN	y	y	y	very often	very often	very often	very often
6LKPP	y	n	y	very often	always	always	always
J4KCG	y	y	y	always	always	always	always
4447J	y	n	y	very often	always	always	always
A84TR	y	y	y	very often	very often	very often	very often
PFRHB	y	y	y	always	always	always	always
BRV2R	y	n	y	very often	sometimes	always	always
TTW3Y	y	y	y	very often	always	always	always
D563C	y	n	y	sometimes	always	always	always
6KM82	y	y	y	sometimes	sometimes	sometimes	sometimes
2DQG2	y	y	y	sometimes	always	always	always
XA57E	y	y	y	always	Always	always	always
YQH24	y	n	y	always	always	always	always
3X4CW	y	y	y	very often	always	always	always
682DZ	y	n	don't know	sometimes	sometimes	sometimes	sometimes
DEQMR	y	y	y	very often	always	always	always
T2H3M	y	n	y	very often	very often	very often	very often
QFMBR	y	y	y	very often	always	always	always
B3R76	y	n	y	always	always	always	always
X8X3L	y	y	y	very often	always	always	always
8VT5G	y	n	y	always	always	always	always

Respondent random ID	Time of investigation	Species of Carp	Water quality	Environ-mental parameters	Fish Necropsy	Fish samples
JHKGF	sometimes	always	very often	very often	sometimes	sometime s
YZSFP	rarely	very often	never	rarely	always	sometime s
M4ABR	always	always	always	always	always	always
Y4CCC	always	always	very often	very often	sometimes	sometime s
NVGCK	very often	very often	sometimes	sometimes	sometimes	rarely
6T4ED	very often	always	always	very often	very often	very often
X4WA9	always	always	sometimes	sometimes	never	never
JE3Z9	always	always	very often	very often	rarely	rarely
SMCHQ	very often	very often	sometimes	very often	rarely	rarely
QE2LG	always	very often	always	always	rarely	sometime s
R3FD9	always	always	never	sometimes	sometimes	sometime s
MMKAM	very often	always	always	very often	sometimes	sometime s
DQ6B6	always	always	very often	always	very often	very often
2AS7T	sometimes	rarely	sometimes	sometimes	rarely	rarely
FYXZB	sometimes	sometimes	very often	sometimes	rarely	rarely
S94W8	always	always	very often	very often	rarely	sometime s
EQ6Q2	always	sometimes	very often	very often	rarely	rarely
6UUUV	always	always	very often	very often	sometimes	sometime s
V2GKW	always	always	always	always	always	always
G2V8C	always	always	very often	very often	rarely	rarely
A6XZL	always	always	sometimes	always	sometimes	sometime s
4AHAZ	always	always	very often	always	sometimes	sometime s
J96EM	always	always	very often	always	sometimes	sometime s
KML43	always	always	always	always	sometimes	sometime

NTHN7	very often	rarely	sometimes	very often	rarely	rarely
J7PLN	sometimes	sometimes	very often	very often	always	very often
TEJRG	very often	very often	very often	sometimes	rarely	rarely
MBWQQ	always	always	sometimes	never	always	always
FDW4C	always	always	sometimes	very often	rarely	sometimes
GRCTN	very often	very often	sometimes	sometimes	sometimes	sometimes
6LKPP	always	always	very often	very often	rarely	rarely
J4KCG	never	always	sometimes	sometimes	always	always
4447J	always	always	always	always	rarely	sometimes
A84TR	rarely	always	very often	never	rarely	sometimes
PFRHB	always	never	very often	very often	rarely	sometimes
BRV2R	very often	very often	very often	very often	no answer	rarely
TTW3Y	always	very often	sometimes	sometimes	always	always
D563C	always	always	sometimes	very often	sometimes	sometimes
6KM82	sometimes	sometimes	rarely	rarely	never	rarely
2DQG2	always	always	always	always	sometimes	sometimes
XA57E	always	always	very often	very often	sometimes	sometimes
YQH24	always	always	very often	sometimes	rarely	sometimes
3X4CW	always	always	always	always	sometimes	sometimes
682DZ	sometimes	rarely	sometimes	sometimes	sometimes	rarely
DEQMR	always	always	sometimes	sometimes	sometimes	sometimes
T2H3M	very often	very often	very often	very often	rarely	rarely
QFMBR	always	always	sometimes	always	always	sometimes
B3R76	always	always	very often	always	sometimes	sometime
X8X3L	very often	always	very often	very often	sometimes	sometime
8VT5G	always	always	always	always	always	always

Appendix I: *Response to Open Ended Questions*

(To maintain confidentiality respondents identified by random code different to that of the survey)

Respondent random ID	Provide a brief description that summarizes how most non-game fish mortality events are processed?
JHKGF	Non-game mortality events are investigated by the fisheries distric office responsible for the body of water involved. The Dept. of environmental management is also notified to assist in the investigations to collect appropriate watrer samples. Fish are identified to species and length, totaled and weights assigned based on lenghts. Fish samples are collected if fresh for parasite disease analysis or toxic compounds. Folowing the investigation a report is provided to the appropriate agenciesto determine if any fines or other assements are needed.
YZSFP	Unfortunately, YZSFP does not fit well with your specific survey question format. As you know, YZSFP does not have any carp but the state has many other species of non-salmonid fishes that are considered rough fish. However, reporting of fish mortality or fish kills to our fish health pathologists is often very vague due to the remoteness of most of the state where there are few if any roads. Therefore, reports often come from bush communities well after an event has occurred with little or no specific information on location, species, water quality, etc. When fish samples are collected they often are unsuitable for adequate necropsy and subsequent investigation. The YZSFP fish health program has all the expertise, capabilities and facilities to diagnose causes of fish kills, but only if the necessary information and samples can be obtained which has been a considerable challenge in this remote state.
M4ABR	Game and non-game fish mortality events are always investigated, the species doesn't matter. The level of the investigation is determined by the cause of the kill or if the kill is easy or difficult to identify. Resource damage investigations may include only routine field and water quality parameters to an investigation that inludes pesticides, metals, organic toxins and tissue analysis.

Y4CCC	We handle all fish mortality events the same whether game fish or non game fish. We examine the situation and determine if water quality issue called the event or if there is a fish health issue, we collect samples when possible but many times events may not be reported for several days and samples may be too far degraded for analysis.
NVGCK	It is very difficuld to investigate non-game fish mortality events. Especially with carp. Most lake managers are happy to see the carp die. If the managers do report it they report it to the water board, then the water board or water managers may report it to NVGCK Fish and Game. The Fish and Game personnel may get around to reporting it to our Fish and Game Fish Health Laboratory. By the time we get notification of a carp die-off it can be weeks to months after the event and collecting data, let alone samples is nearly impossible. If we get timely information we investigate, collect samples, perform full necropsies including virology, bacteriology, parasitology etc. If morts of other species are found we will work them up too.
6T4ED	The questions were specific to wild carp mortality. We have only one instance that was specific to carp (Koi Herpes Virus) that occured during the summer of 2009. Therefore the questions were answered based on one investigation.
X4WA9	Mortality event called in, event is logged in, preliminary investigation to solve, follow-up investigation if necessary
JE3Z9	We have a fish kill investigation protocol that is followed for all fish kills in public waters & those in private waters where requested by pond owner.

SMCHQ	Non-game kills are handled just like game fish kills; typically we get a phone call from the public. We assess how extensive the kill is (dozens of fish or thousands), If kill occurs on a public water, and if it is large in magnatude we usually send a biologist out to investigate. Armed with a DO meter and memory of weather conditions over the past few days, the biologist plays process of elimination to try to determine cause. We don't do detailed counts or send fish off for analysis for most events.
QE2LG	All fish species are included in fish kill investigations
R3FD9	Usually a Biologist is sent out to the mortality site to assess the situation, if the mortality is fresh, obtain a specimen for necropsy, and contact the State Dept. of Health for Water Quality assessment.
MMKAM	MMKAM staff dispatch staff to assess all fish mortality events in the state. Most are related to water quality issues triggered by extreme environmental events (high temperatures and low flows), however we have seen some significant post spawning mortality events where bacterial diseases combine with the stress of spawning events to result in a significant mortality event. On rare occasions, petroleum products or farm chemicals, particularly from Canal Company demossing activities have caused mortality. These events are typically investigated jointly with out Dept. of Agriculture.
DQ6B6	when a member of the public notices mortalities, they contact EPA, local law enforcement or IDNR directly
2AS7T	All chemical-caused fish kills, game and non-game fish, are processed similarly. A Responsible Party is sought and damages pursued according to AFS special publicatoin #30. Fish dieoffs (natural mortality: disease, spawning, etc) are not processed or recorded, unless the magnitude of the kill is significant or the species is one of concern (such as sturgeon).
FYXZB	Investigations follow AFS Publication 30 guidlines and reports sent to a database manager and Fisheries Bureau Chief

S94W8	We do not distinguish between game and non-game fishkills. All are of equal importance. Public reports fishkill, appropriate staff are contacted and follow-up with person who reported incident. If obvious cause and on private land (ex. small privately owned pond), onsite visit may not occur. If public waterbody or reporting entity requests all others investigated on-site. Following a report (based on standard form) is prepared. If necessary follow-up investigation to determine source of problem undertaken.
EQ6Q2	They are processed through our procedural manual for fish kill investigations.
6UUUV	Non game fish mortality events are processed along with game fish events - - we treat them equal we conduct a fish kill investigation according the the agencies standardized fish kill reporting guidelines (adopted from AFS guidelines). Species are noted & counted, sizes either actually obtained or estimates made depending upon time of fish death since the event occurred. All information is recorded on standard forms, and filed with the fisheries management program manager. Kills are summarized in annual reports.
V2GKW	An attempt is made to collect "fresh specimens" by the reporting individual or by the regional fisheries biologist and are taken to our fishhealth lab for necropsies

G2V8C	An alarm form is filled out recording date amd time of report, complainants name, contact number and address, Also included is the waterbody, nearest road or other information to locate the fish, reported species, number involved, freshness of the dead fish, when incident was first observed, and any suspicions of the complainant. Most reports are investigated if the event was observed in the last day, the biologist does not have prior knowledge of the event, and if the magnitude of the event was high enough that the probability of finding dead fish still exists. If dead fish are found during Investigation, GPS coordinates, water quality data, species ID's, and fish counts are conducted/collected. An attempt is made to determine cause and magnitude of each event. Experienced biologists use knowledge of ecology, fish biology, land use, enforcement records, and all other available data to make decisions about what sort of samples are appropriate for a given investigation. Water samples may be taken to rule out or prove discrete pollution events (toxin releases) and characterize the algal community (and toxin levels), fish may be necropsied for histology and bacteriology/virology if disease is a feasible cause. Photographic evidence is usually collected if the event is high in magnitude, or disease or enforceable pollution events are suspected.
A6XZL	interview witness to help determine if natural or pollution event then investigate when necessary
4AHAZ	We are called by the public and we have a fisheries biologist investigate. If serious, they contact our fish health unit for guidance. If fish are morbid or freshly dead, samples are taken for further analysis. In all cases, counts of dead fish by species along with estimated size are made. Water quality staff are also alerted to see if they want to further investigate the fish kill.
J96EM	we invesitigate fish kills with the objectives of detemining extent and cause of the kill. We estimate some/most kills involving gamefish,especially those not related to natural conditions (descibed in question 17)

KML43	When a fish kill involving game and non-game fish is reported to our agency, a biologist is sent immediately to investigate the kill. Water quality measurements are taken, GPS coordinates are recorded, lengths are recorded for each species, and water samples are collected for analyses. Observations are recorded on fish behavior and ambient conditions. A report is completed.
NTHN7	pollution caused kills investigated more thoroughly than natural kills, because natural kills are not enforceable. follow AFS special publication # 30 for field and valuation methods
J7PLN	Report of all fish kills are directed to the State Fish Health Lab. Pertinent information is then collected, ie. time and magnitude of kill, species involved, clinical symptoms observed, water quality concerns, location, mitigating circumstances, etc. A decision is then made as to how to proceed. Sometimes a report of the mortality event is simply filed. Other times a full-blown investigation is initiated. The decision to investigate is based on a number of factors, including: magnitude of mortality, location, availability of fresh samples, clinical signs observed, availability of personnel, etc. The State Fish Health Lab is responsible for all investigations and collects appropriate specimens and samples for further diagnostic work as is necessary and feasible.
TEJRG	In TEJRG, notification and investigation of fish kills are done by our agency (NDEQ) and the Game & Parks commission. All notifications are recorded on a form and investigations are usually conducted when it is believed the kill is due to pollution. Generally, the primary objective of the NDEQ with an investigation is to determine the cause, identify and document a responsible party and pursue legal action follow-up when warranted. The objective of the G & P is to assess the extent of damage. Some natural fish kills are also investigated to assure and document they were actually due to natural causes. All reported fish kills are documented and files shared by both agencies.

MBWQQ	site is visited by a biologist, pictures are taken, if a fresh specimen can be located, it is sampled and sent to a lab for analysis. Approximate number of mortalities are estimated.
FDW4C	Most fish kills we investigate are for "game" species - bass, trout, sunfish, etc.
GRCTN	Non game mortality events are not handled any differently that those that involve game species. The extent of investigation is based up available staffing at the time the event is reported to our agency. All too often reports are days after the event so that fresh samples are not available for necropsy. Also NJ no longer has a fish pathologist for the state so extent of investigation is determined by the expertise of the staff responding. Also, if environmental factors are substantiated as the cause no necropsy would be performed (dissolved oxygen, known pollution event etc..)
6LKPP	Department conservation officers typically investigate fish kills
J4KCG	Regional fish biologists contact me (state fish pathologist) of the event, I then assess whether investigation is warranted. Regional Biologist then send fish to

4447J	Fish kill and fish health data are recorded on a standardized form and sent to the Division’s ESS where the data are reviewed. Fish kill investigation forms and supplemental information sent to the ESB are compiled in a central database where the data can be managed and retrieved for use in reporting to concerned parties and the NC legislature.
A84TR	Our staff investigate. If it's determined that the cause of the mortality is anoxia (common in A84TR) the mortality event is documented and nothing more is done. If the cause is unknown, or suspect a disease outbreak or pollution agent, we will take fish samples and contact the A84TR Department of Health to conduct water analysis to locate the source of the pollutent.
PFRHB	All are investigated as to cause, criminal charges are applied when applicable or a civil settlement is pursued.
BRV2R	Reports from pulic identifying fish kill are taken and shared with the state Environmental Agencies. Fish kill is investigated by field personel. Report is written and supbitted to Environmental biologist.
TTW3Y	Basic necropsy with sampling for viral, bacterial, and parasitic pathogens, examination for physical or chemical trauma.

D563C	Documentation and investigation depends on the severity and timing of the event. Mortality events of relatively few fish and that occur during spawning season are often considered spawning related. Large single species events and moderate to large multi-species events are often investigated. Visual inspection of the kill zone to look for obvious source of pollution event. Water sample collected upstream and within the kill zone on flowing water or within the kill zone on lakes is collected. Number of fish and species of fish are counted and identified. Freshly dead or preferably dying fish are collected and sent to our fish health lab for examination.
6KM82	A Freshwater biologist investigates the complaint and reports to the Section Supervisor. We consider the German carp or ferel koi as invasives.
2DQG2	The magnitude, location, perceived cause, and species involved all comes into play when devoting time to investigating n-g kills. For example, Native fishes involved in unnatural mortality events get more attention than exotic n-g species. Mortality events envolving species we would rather not have present already, certainly don't receive anything more than a cursory glace.
XA57E	All fish kills are handled the same. An investigator goes to the waterbody, takes some preliminary measurements (water temp, dissolved oxygen, pH, water depth). Water and/or fish samples may be collected if deemed appropriate by investigating staff.

YQH24	We process a non-game fish mortality event in a similar manner as we would a sport fish fish kill. A fish kill call would come in to our agency, information on the kill would be recorded, our habitat biologist in the Region would investigate to determine the cause of the kill; if citations are warranted, the would be issued
3X4CW	If the numbers are high, say a few hundred, there will probably be an on-site investigation, unless other investigations involving game species are taking precedence. The location of the event is recorded, the start and end points (GPS) are recorded. Unless it is a relatively small kill or small area affected, we aim to count 10% of the kill (AFS guidelines). Fish are recorded by species and length. Ambient water quality parameters are measured. If there is only one species present, a biological agent will generally be suspected. If there are any good samples (fresh dead fish) we may collect them to have a necropsy performed - the lab will check for viral, bacterial, fungal infections, other diseases. Other samples may be taken (soil, water) if warranted. The investigation findings are then documented in a state database. Detailed investigation summaries are available via open records request.
682DZ	Fish kills that involve acute mortality and other evidence of toxicity are generally handled by conservation officers or regional fisheries biologists. More chronic mortalities or fish showing obvious clinical signs of infectious disease are submitted to the Fish Disease Diagnostic Laboratory. All these cases are thoroughly documented
DEQMR	Communication of fish kills can generally be limited to within the DEQMR Agency of Natural Resources (DEQMR Fish & Wildlife Department and Department of Environmental Conservation). Reports of fish kills are initially forwarded to the appropriate DEQMR Fish & Wildlife Department, District Fisheries Biologists and District Game Warden. The DFB will record details using standard forms. Notification of any investigation and brief follow-up is provided to the District Environmental Enforcement Officer and Department of Environmental Conservation (DEQMR DEC) Water Quality Division staff. Extremely large fish kill events, kills associated with the discharge of toxic chemicals are largely investigated by the DEQMR DEC.

T2H3M	Kill is investigated and the reason for the fish kill is determined by DEQ biologist. Counts of dead fish are made by DEQ biologist. Report is sent to DGIF. Fish replacement cost assessment is made by DGIF using AFS guidelines. The responsible party is billed for fish killed if one can be identified by DEQ enforcement office.
QFMBR	Staff receives a phone call notifying us of the event. Depending on current work loads, a fish pathologist may be sent to the area to assist in collection of moribund carp. The pathologist will then perform a necropsy on the fish either at that location or back at his/her office. Results of the necropsy are then available for interested parties.
B3R76	All fish mortality events are approached the same way in terms of reporting, documentation and valuation in accordance with AFS Special Publication 30.
X8X3L	Fish mortality events in X8X3L (both game and non-game) are investigated/processed primarily by regional X8X3L Department of Natural Resources fisheries biologists and technicians. If deemed necessary, regional fisheries staff may collect water and fish samples for further analysis/testing. I'll email a copy of the X8X3L DNR's fish kill data sheet to Maria Serrano -- the data sheet provides a good summary of how the X8X3L DNR processes fish mortality events (i.e., what data is collected, etc.).
8VT5G	Typically either an angler or biologist reports the event to the regional office, who coordinates with my lab for diagnosis.

Respondent Random ID	**Provide any thoughts concerning the best way to manage or document current and future non-game freshwater fish mortality events?**	**Any comments related to above questions?**

JHKGF	N/A	N/A
YZSFP	An agency hierarchy should be in place with one agency taking the lead that receives mortality reports, collects information and disseminates samples, data to be processded by the partner agencies.	
M4ABR		The questions were specific to wild carp mortality. We have only one instance that was specific to carp (Koi Herpes Virus) that occured during the summer of 2009. Therefore the questions were answered based on one investigation.
Y4CCC	They should be handled the same as any game fish mortality event.	The event we experienced was on the mississippi river and included silver carp and bighead carp.
NVGCK	When we are informed of a carp die-off in a timely manner (rarely) we collect most, if not all data asked for in questions 6-12 and a pathology report is written and filed by the case pathologist	We fully work up any wild fish die-off that we are inormed of and can collect samples from. in many cases we don't get notification until it is too late. That is why we don't fully work up all cases. Another factor for lack of response is employee workload and short staffing. We just don't have the people available to help us collect the samples and get them to the lab or do the work that needs to be done. NVGCK is a very large,

		geographically diverse state which makes it difficult to respond to every need.
6T4ED	A collection report is completed with all of the above information. A hard copy of the report is kept in files for the water body and on a database.	No answer
X4WA9	As above in #15. All events are investigated preliminarily with follow-up if deemed necessary.	I have never investigated a wild carp mortality event. Most events called in are for game species.
JE3Z9		no answer
SMCHQ	We try to enter all reports of fish kills into our database so we can see frequency of occurence to see if trends are revealed.	Wild carp occur in the SMCHQ rivers and kills are very rare. The SMCHQ has most of the lakes where kills involving shad and non-native tilapia are very common. We do keep records by county but not all

		kills are investigated by a biologist.
QE2LG	The Fisheries Section responds to all freshwater fish kill reports	
R3FD9	For our agency, it's keeping written records.	None
MMKAM	It would be beneficial to have both a statewide and national database to record mortality events. Most western states use the standard AFS protocol to investigate and determine monitary loss of fish from a mortality event.	It is our Department philosophy that game and nongame fish are of equal importance and mortality caused by negligence should be investigated in the same manner and value of the fish recovered from the responsible party. Fortunately, in MMKAM, mortality events happen on an infrequent basis. Regional staff are trained and equiped to investigate most potential causes of mortality and we have a mobile fish health lab and staff to assist.
DQ6B6	by following the proceedures outlined in the American Fisheries Society fish kill investigation manual - Special Publication 30	We have altered the investigation reporting to be consistent with the requirements of the Illinois Attorney General for legal action against point source polluters

2AS7T	Access database. This is what we use for our fish kills. Easy to query for the information we might need, and generate reports.	2AS7T nomenclature: "fish kill" is due to a chemical, hot water discharge, or other human-associated cause. "Die off" is naturally-occurring, such as disease (eg. spring viremia or others), spawning, etc. In 2003 or 2004, 2AS7T did investigate a carp dieoff and sent 1 sample for necropsy. That was when spring viremia first came out. Talking to 4 of the 6 fisheries districts, we do not investigate natural dieoffs unless the number dead is very large, it is a different suspected disease (VHS, botulism, etc), or the species is one of special interest (eg. sturgeon)
FYXZB	A central database that records all types of fish mortality events.	owa maintains a database recording fish kill events and connects them to a cause, if known. Events are investigated by our Environmental Services Division as well as our Fisheries Bureau.
S94W8	Standard protocol. Base on AFS guidelines. Managment of incident, somewhat incident specific.	Number 14 is pretty broad. Are species identification and counts samples or does it only refer to tissue or whole fish samples sent to a lab facility. Number 11, water quality parameters, also very broad. Does it mean measurements as simple as on-site measurement of temperature or detailed laboratory analysis of water quality.

EQ6Q2		Wild carp are counted as part of our over all fish kill investigations. We have not many wild carp kills only.
6UUUV	None at this time	None
V2GKW	Each State needs to have a policy on investigating fish kills- game or non-game species.	V2GKW has one major European carp population that is predominately in the tidal, freahwater estuary which is not in my Dept's jurisdiction. However, any major carp mortalities would be brought to our fish pathologist/vet for necropsy.
G2V8C	Aside from the above (question 15), developing a good database to store the data is also very important. Transferring field notes into a standard format as soon as possible is also highly advisable.	G2V8C experienced and thoroughly investigated a major, statewide, common carp die-off in 2000
A6XZL	we document all aspects from the time a kill is reported and have an MOU in place to determine cause and damage	

4AHAZ	They are very random occurances in our state at this time. Many do not get much additional analysis because they are often spring events associated with winterkill or high stress periods like spawning periods. At minimum, a good database of locations should be maintained and any patterns examined.	
J96EM	Whenever a necopsy is involved, our pathilogy lab keeps recors. The only way to manage, that is, diminish, the frequency of fish kills is to improve water quality, especially by addressing nutrient inputs from agriculture. We document winterkill events (described in next question) and some summer kill events with our survey database.	Be advised that In J96EM we have commonly observe summer-kill and winter-kill events that may/may not involve carp popluations. Summer-kill events involve low hypolimnion oxygen in dimictic lakes, which affects cold-cool water species like ciscos, and uncommonly, carp. We also observe columnaris or other bacterial infections, typically in May-June - these may involve carp. Winterkill events occur when oxygen levels are depleted due to prolonged snow cover on shallow lakes; these can involve carp.
KML43	When fish kill reports are submitted, we attach a coversheet to the report requesting specific information. The coversheet includes: Date of Kill, Waterbody, Limits of Kill, County, Basin, Probable Cause, Species Affected, Investigator, and Total Number of Dead Fish. This information is entered into a spreadsheet.	none

NTHN7	the initial response time to report to the scene of a kill is always an aspect to improve on. For other states, using monetary damaages or increasing the monetary damages for dead fish would provide more incentive for investigators to report to the scene	to any of the above questions is appreciated: for more clarification contact me at
J7PLN		Some of these questions were difficult to answer since the decision of how or when to investigate a mortality event can be a complex one. Quite often an investigation is warranted but not undertaken due to the extended time since the mortality event occured and/or the lack of suitable samples for examination. We do take all fish kills seriously and if the problem is large and widespread enough, a commitment would be made to find staff to investigate. Also, please understand that these questions were answered somewhat from the standpoint of "what would we do?" rather than just "what have we done", since we have not seen any mortality events of carp in recent years.
TEJRG	Presently we have a process in place to manage and document fish kills and don't anticipate any major changes.	None

MBWQQ	A checklist should be developed, maybe to include: Time, date, pictures, fish collected, water quality, weather, anything suspicious, interview people present, etc.	No answer
FDW4C	Most fish kills we investigate are for "game" species - bass, trout, sunfish, etc.	We are not terribly concerned about "wild carp" so I substituted "wild non-game fish" in answering the questions.
GRCTN	Hiring of a fish pathologist - benefits both non game & game species	Beleive an important question (if I am following the logic behind the survey) is to ask if reports of non-game mortality revents are investigated any differently than those of game species. As well as, what restricts/limits your agency in investigating fish kills, and finally under what cirecumstances will your agency not investigate a report. Believe you will find it is more due to staffing limitations than nongame vs game issue, and also we often get reports of only 5 or ten dead fish within a waterbody which will not be investigated.

6LKPP		No answer
J4KCG	Entirely up to the state and every state has a different perspective.	
4447J	Keep reporting forms and protocols simple and easy to use. All investigators should be trained in an agreed upon set of protocols.	
A84TR		Most of our fish kills are attributable to low dissolved oxyen during winter and summer periods. We attempt to document these as well as possible, but don't go much beyond simple water quality measurements unless we suspect another factor may have caused the kill.
PFRHB	Our current system works well, however, there are some gaps in communication with overlapping agencies. Fish kills are a priority for our agency.	

BRV2R		# 16 is a bit vague. I am not sure what exactly you are looking for
TTW3Y	Fish examinations from any species are entered in a central Filemaker database. The database can evolve to include data of interest as trends develop. This centralized database is accessed by all pathologists in the group.	no answer
D563C	On a national scale it will require someone to house a web based system that would allow users both easy access to their data and national data but also provide for easy input of data into the system. The difficult part would be providing everyone with all of the information that they would need to store. This is likely to vary greatly between individual states. Manpower often determines our ability to fully investigate all freshwater fish kills. We do not treat non-game kills any different than game kills. A kill is a kill. We do not have an easily searchable fish kill database withinstate. I would start there. Instead of having the investigators report their findings on field data sheets only make them input the data into a searchable database where trends and patterens can be looked for and shared with others.	good luck

6KM82	A spreadsheet	We do not consider carp as important other than invasive and destructive to warmwater species and trout habitat.
2DQG2	A fill in the blank data base, similar to this questionaire would be a step in the right direction.	Over the years (26) on 2DQG2 Reservoir, we have observed several spring common carp mortality events. The last two have received considerable attention, because of concern for the disease spreading to triploid grass carp or to native cyprinids, particularly a restoration species, Robust Redhorse. I can recall an event in the early 90's that I was assigned to investigating, but it was so far after the fact that nothing could be discerned other than it was a single species disease issue, but since it was 'just common carp', no one lost any sleep over it.
XA57E	Fish kills are documented in a database with a link to data and photos.	Non-game and game fish mortality events are treated the same way.

YQH24	Handle all fish kills in the same manner.	No comments.
3X4CW		no answer
682DZ	Fish kills that involve acute mortality and other evidence of toxicity are generally handled by conservation officers or regional fisheries biologists. More chronic mortalities or fish showing obvious clinical signs of infectious disease are submitted to the Fish Disease Diagnostic Laboratory. All these cases are thoroughly documented	Wild carp are considered an invasive species and a nuisance, hence do not elicit as much response at native species.
DEQMR	1) Establish a clear understanding of the specific roles and responsibilities of all involved parties. 2) Describe a communication link between all key people needed for an effective response. 3) Describe the limits of authority for all non-enforcement staff. 4) Describe the appropriate data collection and reporting methods for the variety of types and scales of common fish kill events.	For suspected fish pathogens, fish should be necropsied and tested by qualified fish health professionals.
T2H3M		No answer

QFMBR		no answer
B3R76	We are would like to enhance our agency's capabilities in assessing mortality associated with fish disease.	no answer
X8X3L		no answer
8VT5G	Make sure the parameters listed above are always recorded.	no answer

Appendix J: *Ranking Sort Data*

For questions 6-14, pertaining to how often particular information is collected in an investigation of a wild carp mortality event (Always = 2, Very often = 1, Sometimes = 0, Rarely = -1, Never = -2), (To maintain confidentiality respondents identified by random code different to that of the survey)

Respondent random ID	Investigation	Location	Date reported	Date of investigation	Time of investigation	Species of Carp	Water quality	Environmental parameters
JHKGF	2	2	2	2	0	2	1	1
YZSFP	0	0	0	0	-1	1	-2	-1
M4ABR	2	2	2	2	2	2	2	2
Y4CCC	1	1	2	2	2	2	1	1
NVGCK	2	2	1	1	1	1	0	0
6T4ED	1	2	2	2	1	2	2	1
X4WA9	2	2	2	2	2	2	0	0
JE3Z9	2	2	2	2	2	2	1	1
SMCHQ	0	1	1	1	1	1	0	1
QE2LG	2	2	2	2	2	1	2	2
R3FD9	2	-2	2	2	2	2	-2	0
MMKAM	2	1	1	1	1	2	2	1
DQ6B6	2	0	2	2	2	2	1	2
2AS7T	0	0	0	0	0	-1	0	0
FYXZB	1	0	1	2	0	0	1	0
S94W8	1	1	2	2	2	2	1	1
EQ6Q2	2	2	2	2	2	0	1	1
6UUUV	1	1	2	2	2	2	1	1

V2GKW	1	2	2	2	2	2	2	2
G2V8C	1	2	2	2	2	2	1	1
A6XZL	0	2	2	2	2	2	0	2
4AHAZ	2	2	2	2	2	2	1	2
J96EM	0	2	2	2	2	2	1	2
KML43	2	2	2	2	2	2	2	2
NTHN7	1	2	2	2	1	-1	0	1
J7PLN	1	2	2	2	0	0	1	1
TEJRG	1	2	2	2	1	1	1	0
MBWQQ	2	2	2	2	2	2	0	-2
FDW4C	0	2	2	2	2	2	0	1
GRCTN	1	1	1	1	1	1	0	0
6LKPP	1	2	2	2	2	2	1	1
J4KCG	2	2	2	2	-2	2	0	0
4447J	1	2	2	2	2	2	2	2
A84TR	1	1	1	1	-1	2	1	-2
PFRHB	2	2	2	2	2	-2	1	1
TTW3Y	1	2	2	2	2	1	0	0
D563C	0	2	2	2	2	2	0	1
6KM82	0	0	0	0	0	0	-1	-1
2DQG2	0	2	2	2	2	2	2	2
XA57E	2	2	2	2	2	2	1	1
YQH24	2	2	2	2	2	2	1	0
3X4CW	1	2	2	2	2	2	2	2
682DZ	0	0	0	0	0	-1	0	0
DEQMR	1	2	2	2	2	2	0	0
T2H3M	1	1	1	1	1	1	1	1
QFMBR	1	2	2	2	2	2	0	2

B3R76	2	2	2	2	2	2	1	2
X8X3L	1	2	2	2	1	2	1	1
8VT5G	2	2	2	2	2	2	2	2
Total	58	74	83	84	67	69	36	41
Average	1.18	1.51	1.69	1.71	1.37	1.41	0.73	0.84
Standard deviation	0.75	0.87	0.62	0.61	0.99	1.02	0.95	1.03

Respondent random ID	Fish necropsy	Fish samples	Sum of scores	Average score	Standard deviation
JHKGF	0	0	12	1.2	0.92
YZSFP	2	0	-1	-0.1	1.10
M4ABR	2	2	20	2	0.00
Y4CCC	0	0	12	1.2	0.79
NVGCK	0	-1	7	0.7	0.95
6T4ED	1	1	15	1.5	0.53
X4WA9	-2	-2	8	0.8	1.69
JE3Z9	-1	-1	12	1.2	1.23
SMCHQ	-1	-1	4	0.4	0.84
QE2LG	-1	0	14	1.4	1.07
R3FD9	0	0	6	0.6	1.65
MMKAM	0	0	11	1.1	0.74
DQ6B6	1	1	15	1.5	0.71
2AS7T	-1	-1	-3	-0.3	0.48
FYXZB	-1	-1	3	0.3	0.95

S94W8	-1	0	11	1.1	0.99
EQ6Q2	-1	-1	10	1	1.25
6UUUV	0	0	12	1.2	0.79
V2GKW	2	2	19	1.9	0.32
G2V8C	-1	-1	11	1.1	1.20
A6XZL	0	0	12	1.2	1.03
4AHAZ	0	0	15	1.5	0.85
J96EM	0	0	13	1.3	0.95
KML43	0	0	16	1.6	0.84
NTHN7	-1	-1	6	0.6	1.26
J7PLN	2	1	12	1.2	0.79
TEJRG	-1	-1	8	0.8	1.14
MBWQQ	2	2	14	1.4	1.35
FDW4C	-1	0	10	1	1.15
GRCTN	0	0	6	0.6	0.52
6LKPP	-1	-1	11	1.1	1.20
J4KCG	2	2	12	1.2	1.40
4447J	-1	0	14	1.4	1.07
A84TR	-1	0	3	0.3	1.25
PFRHB	-1	0	9	0.9	1.45
TTW3Y	2	2	14	1.4	0.84
D563C	0	0	11	1.1	0.99
6KM82	-2	-1	-5	-0.5	0.71
2DQG2	0	0	14	1.4	0.97
XA57E	0	0	14	1.4	0.84
YQH24	-1	0	12	1.2	1.14
3X4CW	0	0	15	1.5	0.85
682DZ	0	-1	-2	-0.2	0.42

DEQMR	0	0	11	1.1	0.99
T2H3M	-1	-1	6	0.6	0.84
QFMBR	2	0	15	1.5	0.85
B3R76	0	0	15	1.5	0.85
X8X3L	0	0	12	1.2	0.79
8VT5G	2	2	20	2	0.00
Total	-1	0	511	51.1	
Average	-0.02	0.00	10.43	1.04	
Standard deviation	1.15	0.96	5.55	0.56	

Appendix K: *Response Time and Questionnaire Response*

Introduction

To identify if any potential patterns to response time or the variability of the responses, I examined several variables to look for relationships. These variables included:

1. Total number of aquaculture farms
2. Number of freshwater aquaculture farms
3. Proportion of freshwater aquaculture farms to total aquaculture farms
4. Reports of previous Koi Herpes Virus (KHV) or Spring Viremia of Carp outbreaks (SVC)
5. Respondent indicating previous carp mortality events on the questionnaire
6. States with coastline
7. Red or blue state in 2008 and 2010, and according to both the governorship and majority of the legislature
8. Number of sport aquaculture farms
9. Number of ornamental aquaculture farms
10. Number of carp aquaculture farms
11. Number of food aquaculture farms
12. Number of saltwater aquaculture farms
13. Reminders

This exercise did identify one statistically significant (p value <0.05) pattern between response time and coastline states (p value = 0.04). The rest of these exercises did not identify any statistically meaningful patterns (Table 1), but negative results can be of value so I include them in this appendix. The JMP Pro 9.2 (64-bit edition, SAS Institute Inc.) was used for all statistical analyses.

Variables compared to response time and survey response score, including what test was used and p-value results.

	Variable	Statistical Test	P-value
Response time	Total aquaculture farm	Wilcoxon/Kruskal-Wallis	0.17
	Total aquaculture farm	Survival analysis	0.42
	Freshwater farms	Wilcoxon/Kruskal-Wallis	0.07
	Proportion of freshwater farms	Survival analysis	0.52
	Proportion of saltwater farms	Survival analysis	0.47
	Coastal states* **	Survival analysis	**0.04**
	Red/blue states according to governorships 2007-2010	Survival analysis	0.58
	Red/blue states 2008 presidential election	Survival analysis	0.60
	KHV/SVC outbreak	Fisher's exact	0.60
	KHV/SVC outbreak	Survival analysis	0.31
	Carp mortality	Survival analysis	0.53
Survey response score	**Variable**	**Test**	**p value**
	Total aquaculture farm	Linear regression	0.52
	Sport farms	Linear regression	0.47
	Ornamental farms	Linear regression	0.21
	Carp farms	Linear regression	0.62
	Food farms	Linear regression	0.15
	Saltwater farms	Linear regression	0.83
	Freshwater farms	Linear regression	0.39

	Proportion of freshwater farms	Linear regression	0.26
	Proportion of saltwater farms	Linear regression	0.14
	Response time	Linear regression	0.53
	Coastline states	Wilcoxon/Kruskal-Wallis	0.99
	Red/blue states according to governorships 2007-2010	Wilcoxon/Kruskal-Wallis	0.68
	Red/blue states 2008 presidential election	Wilcox/Kruskal-Wallis	0.24
	KHV/SVC outbreak	Wilcox/Kruskal-Wallis	0.33
	Carp mortality	Wilcox/Kruskal-Wallis	0.82
	Reminders	Wilcox/Kruskal-Wallis	0.52
	Reminders	Wilcox/Kruskal-Wallis	0.40

Response Time Pattern Assessments

Response Time Data Analysis Methods

Question 1: Is the response time dependent on the number of aquaculture farms?

The hypothesis was that states with higher number of aquaculture farms would have a quicker survey response time. To answer this question, two statistical tests were used (Wilcoxon/Kruskal-Wallis and survival analysis). The continuous variable, number of aquaculture farms was compared to the nominal categorical response time (states responding <1 day or > 1 day) (Table 3). Response time, as a continuous variable was also compared to the aquaculture farm using survival analysis (Figure 1). The number of total aquaculture farms was taken from the 2005 United States Department Agriculture 2005 census of aquaculture production was included (Table 2).

Question 2: Is the response time dependent on the number of freshwater aquaculture farms?

The hypothesis was the states with a larger number of freshwater aquaculture farms are more likely to respond to the survey in < 1 day. A nonparametric analysis, Wilcoxon/Kruskal-Wallis was used to find a relationship between the continuous variable, freshwater aquaculture farms and the categorical variable, response time (<1 day or > 1 day) (Table 4).

The number of freshwater aquaculture farms was taken from the 2005 United States Department Agriculture 2005 census of aquaculture production was included (Table 2).

Question 3: Is the response time dependent on if states have a higher proportion of freshwater aquaculture farms versus saltwater farms?

It was hypothesized that states with larger proportion of freshwater aquaculture farms versus saltwater farms are more likely to respond faster. The numbers of freshwater and saltwater aquaculture farms and total aquaculture farms were taken from the 2005 United States Department Agriculture 2005 census of aquaculture production (Table 2). The proportion of freshwater aquaculture farms for each state was generated by dividing the number of freshwater aquaculture farms by the total number of aquaculture farms for that state. The proportion of saltwater farms was derived similarly. These proportions were used in the survival analysis to find a relationship between the continuous variable of response time compared to the proportion of freshwater and proportion of saltwater farms using survival analysis (Figure 2).

Question 4: Does the response time differ for states with previous KHV or SVC outbreaks versus states with no previous outbreaks?

It was hypothesized that states with previous KHV or SVC outbreaks prior to the questionnaire, are more likely to respond <1 day. Do states that have had KHV or SVC outbreaks in the past differ in response time from states with no previous KHV or SVC outbreaks? To answer this question, two statistical tests were used (Fisher exact test and survival analysis). The categorical variable, states with previous KHV/SVC outbreaks was compared to the categorical response time (states responding <1 day or > 1 day) using the fisher's exact test (Table 5). Response time, as a continuous variable was also compared to the states with previous SVC/KHV using survival analysis (Figure 3). The reported KHV or SVC outbreaks were generated from published outbreaks and the pilot study (Appendix A, Hedrick et al. 2000, Goodwin 2002, Dikkeboom et al. 2004, Grimmett et al. 2006, Warg et al. 2007, Garver et.al 2007).

There was also no statistical significant relationship between states reporting carp mortality or KHV/SVC and response time (Table 1).

Question 5: Does response time differ between states that reported having carp mortality events on the questionnaire versus states that didn't report carp mortality events?

It was hypothesized that states that indicated having previous carp mortality events in the questionnaire would respond faster. To answer this question, a survival analysis was used to compare the categorical variable (states with carp mortalities [yes, no, don't know]) to the continuous variable (response time) (Figure 4).

Question 6: Does response time differ between states with coastline versus states with no coastline?

It was hypothesized that states with a coastline would respond faster. A total of 30 states have a coastline (including ocean coast, golf coast, and Great Lake coast). To answer this question, a survival analysis was used to compare the categorical variables (states with coastline [yes, no]) to the continuous variable (response time) (Figure 5).

There was statistical significant relationship between coastline states and response time (p value = 0.04, Table 1).

Question 7: Does response time differ between politically red and blue states?

It was hypothesized that blue states would respond faster. This data was generated using the 2007-2010 governorship and 2008 presidential election.
To answer this question, a survival analysis was used to compare the categorical variables (red or blue state) to the continuous variable (response time) (Figure 6).

Survival analysis

When using survival analysis, the outcome variable was the time until a response is received and the event was the response. The time variable, is the survival time and each state was given a corresponding survival time up to an event occurring. In this study there is no censor because all individual respondent by the end of the study. The overall survival analysis description for the response curve can be seen in Figure 7.

Survey Response Pattern Assessments

Survey Response Data Analysis Methods

Each state was designated a particular score depending on the response to how often reported events were investigated and particular information was collected. It was scored using a five point scale: Never (-2), Rarely (-1), Sometimes (0), Very often (1), Always (2). If no answer was provided for any of these questions or if a respondent replied rarely or never to "How often reported events are investigated" the respondent was removed from the analysis. A total of 49 states were analyzed in this method. After each response was scored, the values of all responses were totaled to achieve a score for each state. The minimum survey response score possible was negative 20 and the maximum survey response score was 20 (Table 6, Appendix J). This survey response score was then used to identify any potential pattern to the variation of each state.

Question 1: Are the states' survey response score dependent on the number of aquaculture farms?

It was hypothesized that states with higher number of aquaculture farms would have a higher survey response score. To answer this question, the continuous variables, total aquaculture farms, were compared to the state's survey response scores using a linear regression model

(Figure 8).   The number of total aquaculture farms was taken from the 2005 United States Department Agriculture 2005 census of aquaculture production (Table 3).

Question 2: Are the states' survey response score dependent on the number of freshwater farms or sport aquaculture farms or ornamental farms or carp farms or food farms or saltwater farms?

It was hypothesized that states with large number of freshwater farms, sport aquaculture farms, ornamental farms, carp farms, food farms, or saltwater farms would have a higher survey response score. To answer this question, the continuous variables (freshwater farms, sport aquaculture farms, ornamental farms, carp farms, food farms, or saltwater farms) were compared to the state's survey response scores using a linear regression model (Figure 8, 9, 10, 11, 12, 13, 14).   The numbers of freshwater farms, sport aquaculture farms, ornamental farms, carp farms, food aquaculture farms, or saltwater farms were taken from the 2005 United States Department Agriculture 2005 census of aquaculture production (Table 2).

Question 3: Are the states' survey response score dependent on if states have a higher proportion of freshwater aquaculture farms versus saltwater aquaculture farms?

It was hypothesized that states with larger proportion of freshwater aquaculture farms versus saltwater farms will have a higher survey response score. The numbers of freshwater and saltwater aquaculture farms and total aquaculture farms were taken from the 2005 United

States Department Agriculture 2005 census of aquaculture production (Table 2). The proportion of freshwater aquaculture farms for each state was generated by dividing the number of freshwater aquaculture farms by the total number of aquaculture farms for that state. The proportion of saltwater farms was derived similarly. To answer this question, the proportion of freshwater and proportion of saltwater farms were compared to the state's survey response scores using a linear regression model (Figure 15).

Question 4: Do states with previous KHV or SVC outbreaks survey response scores differ from states with no previous KHV or SVC outbreaks?

It was hypothesized that states with previous KHV or SVC outbreaks prior to responding to the questionnaire would have a higher survey response score. To answer this question, a Wilcoxon/Kruskal-Wallis was done to compare the categorical variables (previous KHV/SVC outbreaks) to the continuous variable (survey response score) (Figure 16). The reported KHV or SVC outbreaks were generated from published outbreaks and the pilot study (Appendix A, Hedrick et al. 2000, Goodwin 2002, Dikkeboom et al. 2004, Grimmett et al. 2006, Warg et al. 2007, Garver et.al 2007).

There was also no statistical significant relationship between states reporting carp mortality or KHV/SVC and survey response score (Table 1).

Question 5: Does survey response score differ between states that reported having carp mortality events on the questionnaire versus states that didn't report carp mortality events?

It was hypothesized that states that indicated having previous carp mortality events in the questionnaire will have a higher survey response score. To answer this question, a Wilcoxon/Kruskal-Wallis was done to compare the categorical variables (states with carp mortalities [yes, no, don't know]) to the continuous variable (survey response score) (Figure 17).

Question 6: Does survey response score differ between states with coastline versus states with no coastline states

It was hypothesized that states with a coastline would have a higher survey response score. A total of 30 states have a coastline (including ocean coast, golf coast, and Great Lakes coast).

To answer this question, a Wilcoxon/Kruskal-Wallis was done to compare the categorical variables (states with coastline [yes, no]) to the continuous variable (survey response score) (Figure 18).

Question 7: Does survey response score differ between political red and blue states?

It was hypothesized that blue states would have a higher survey response score. This data was generated using the 2007-2010 governorships election and 2008 presidential election. To answer this question, a Wilcoxon/Kruskal-Wallis was done to compare the categorical variables (red or blue state) to the continuous variable (survey response score) (Figure 19).

Question 8: Are the states' survey response score dependent on the response time?

It was hypothesized that states with higher survey response score would have responded faster. To answer this question, the continuous variables, response time, was compared to the state's survey response scores using a linear regression model (Figure 20).

Question 9: Does survey response score differ between states that responded before the first reminder versus states after each reminder (1^{st}, 2^{nd}, and 3^{rd} reminder).

It was hypothesized that the survey response score would differ if the states had received a reminder. Group 1 was the states that responded with no reminders, group 2 was the states that responded with one reminder, group 3 was states that responded with the second reminder, and group 4 was the states that responded with the third reminder. To answer this question, the groups' survey response scores were compared by using Wilcoxon/Kruskal-Wallis test (Figure 21, Figure 22).

Results of Data Analysis

This exercise did identify one statistically significant (p value <0.05) pattern between response time and if a state had coastline (p value = 0.04). The rest of these exercises did not identify any statistically meaningful patterns (Table 1).

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Variables used to find a pattern in the relationship between response time and survey response score.

	Observed response time	Categorical response time *	Numerical response time	Total aquaculture farms	Saltwater farms	Freshwater farms	Proportion of freshwater farms	Proportion of saltwater farms	Prior carp mort on survey
JHKGF	4 days	1	4	215	2	213	0.99	0.01	y
YZSFP	<1 day	0	1	26	25	1	0.04	0.96	n
M4ABR	4.5	1	5	11	0	11	1.00	0.00	n
Y4CCC	28 days	1	29	211	0	211	1.00	0.00	y
NVGCK	<1 day	0	1	118	22	96	0.81	0.19	y
6T4ED	<1 day	0	1	15	0	15	1.00	0.00	y
X4WA9	7	1	7	30	0	3	0.10	0.00	n
JE3Z9	<1 day	0	1	3	0	3	1.00	0.00	y
SMCHQ	<1 day	0	1	359	163	196	0.55	0.45	n
QE2LG	29 days	1	29	79	1	78	0.99	0.01	n
R3FD9	<1 day	0	1	59	30	33	0.56	0.51	n
MMKAM	<1 day	0	1	35	0	35	1.00	0.00	n
DQ6B6	<1 day	0	1	47	1	47	1.00	0.02	y
2AS7T	<1 day	0	1	18	1	17	0.94	0.06	y
FYXZB	<1 day	0	1	21	0	21	1.00	0.00	y
S94W8	14 days	1	14	12	0	12	1.00	0.00	y
EQ6Q2	<1 day	0	1	65	0	65	1.00	0.00	y
6UUUV	<1 day	0	1	873	135	738	0.85	0.15	y
V2GKW	4.5	1	5	50	40	10	0.20	0.80	n

G2V8C	11.5	1	12	86	75	11	0.13	0.87	n
A6XZL	<1 day	0	1	157	140	18	0.11	0.89	y
4AHAZ	<1 day	0	1	34	1	34	1.00	0.03	n
J96EM	<1 day	0	1	77	0	77	1.00	0.00	y
KML43	<1 day	0	1	403	1	403	1.00	0.00	y
NTHN7	7 days	1	7	35	0	35	1.00	0.00	y
J7PLN	3 days	1	3	8	0	8	1.00	0.00	n
TEJRG	1.5 days	1	2	26	0	26	1.00	0.00	y
MBWQQ	6 days	1	6	0	0	0	0.00	0.00	y
FDW4C	<1 day	0	1	10	6	5	0.50	0.60	don't know
GRCTN	7.5	1	8	87	70	17	0.20	0.80	y
6LKPP	33.5	1	34	3	0	3	1.00	0.00	n
J4KCG	<1 day	0	1	54	13	41	0.76	0.24	y
4447J	<1 day	0	1	186	57	129	0.69	0.31	n
A84TR	<1 day	0	1	1	0	1	1.00	0.00	y
PFRHB	8 days	1	8	55	0	55	1.00	0.00	y
BRV2R	15 days	1	15	20	0	20	1.00	0.00	n
TTW3Y	<1 day	0	1	47	21	26	0.55	0.45	y
D563C	<1 day	0	1	56	0	56	1.00	0.00	n
6KM82	16 days	1	16	12	11	2	0.17	0.92	y
2DQG2	<1 day	0	1	85	45	43	0.51	0.53	y
XA57E	2 days	1	2	7	0	7	1.00	0.00	y
YQH24	8 days	1	8	45	0	45	1.00	0.00	n
3X4CW	<1 day	0	1	95	19	79	0.83	0.20	y
682DZ	<1 day	0	1	11	0	11	1.00	0.00	n

DEQMR	21 days	1	21	9	0	9	1.00	0.00	y
T2H3M	<1 day	0	1	147	122	28	0.19	0.83	n
QFMBR	3.5 days	1	4	194	175	21	0.11	0.90	y
B3R76	<1 day	0	1	21	0	21	1.00	0.00	n
X8X3L	11 days	1	11	84	0	84	1.00	0.00	y
8VT5G	20 days	1	20	7	0	7	1.00	0.00	n

*categorical (0 for response <1 day), (1 for response >1 day)

Respondent random ID	Previous KHV/SVC outbreak	Coastline	Red/blue state according to governorships elections 2007-2010	Red/blue state 2008 according presidential election
JHKGF	N	y	R	R
YZSFP	N	y	R	R
M4ABR	N	n	R	R
Y4CCC	N	n	B	R
NVGCK	Y	y	B	B
6T4ED	N	n	B	B
X4WA9	N	y	B	B
JE3Z9	N	y	B	B
SMCHQ	N	y	R	B
QE2LG	N	y	R	R
R3FD9	N	y	B	B
MMKAM	N	n	R	R
DQ6B6	Y	y	B	B
2AS7T	N	y	R	B
FYXZB	N	n	R	B
S94W8	N	n	R	R
EQ6Q2	N	n	B	R
6UUUV	N	y	R	R
V2GKW	N	y	R	B
A6XZL	N	y	B	B
4AHAZ	N	y	R	B
J96EM	N	y	B	B
KML43	N	y	R	R
NTHN7	Y	n	B	R
J7PLN	N	n	B	R
TEJRG	N	n	R	R
MBWQQ	N	n	R	B
FDW4C	N	y	B	B
GRCTN	N	y	B	B
6LKPP	N	n	R	B
J4KCG	Y	y	B	B
4447J	Y	y	B	B
A84TR	N	n	R	R

PFRHB	N	y	R	B
BRV2R	N	n	R	R
TTW3Y	N	y	B	R
D563C	N	y	R	B
6KM82	N	y	B	B
2DQG2	Y	y	R	R
XA57E	N	n	R	R
YQH24	N	n	R	R
3X4CW	N	y	R	R
682DZ	N	n	R	R
DEQMR	N	n	B	B
T2H3M	N	y	B	B
QFMBR	Y	y	B	B
B3R76	N	n	B	R
X8X3L	Y	y	R	B
8VT5G	N	n	R	R

Statistical Results for Response Time

Statistical results of response time versus total aquaculture farms using Wilcoxon/Kruskal-Wallis

Wilcoxon/Kruskal-Wallis test					
Response (Y): Total Aquaculture Farm from the United States 2005 Census of Aquaculture and Factor (X)= Response time (<1 day or >1 day)					
Wilcoxon/Kruskal Wallis Test (Rank Sums)					
Level	Count	Score sum	Expected score	Score mean	Mean-mean/std
0	27	760	688.5	28.15	1.38
1	23	515	586.5	22.39	-1.38
2-sample test, normal, approx.					
S	z	Prob>(z)	2,tail pval		
515	-1.3	0.17	0.08		
1 way test, Chi square approx.					
Chi square	DF	Prob>Chi square			
1.94	1	0.16			

Response time versus freshwater farms using Wilcoxon/Kruskal-Wallis

Wilcoxon/Kruskal-Wallis test						
Response (Y): Total freshwater farms from the United States 2005 Census of Aquaculture and Factor (X)= Response time (<1 day or >1 day)						
Wilcoxon/Kruskal Wallis Test (Rank Sums)						
Level	Count	Score sum	Expected score	Score mean	Mean-mean/std	
0	27	781.5	688.5	28.94	1.80	
1	23	493.5	586.5	21.45	-1.80	
2-sample test, normal, approx.						
S	z	Prob>(z)	2,tail pval			
493.5	-1.80	0.07	0.035			
1 way test, Chi square approx.						
Chi square	DF	Prob>Chi square				
3.28	1	0.07				

States with previous KHV/SVC outbreak response time versus states with no previous KHV/SVC

Fisher's Exact Test				
Variables:				
Previous KHV/SVC outbreaks (yes or no)				
Response time (<1 day or >1 day)				
Total yes	**Total No**	**Total <1 day**	**Total > 1 day**	**N**
8	42	27	23	50
	Yes	**NO**		
<1 day	5	22		
>1 day	3	20		
N	**DF**			
50	1			
Test	**Chi square**	**Prob>Chi**		
Likelihood ratio	0.28	0.60		
Pearson	0.28	0.60		
Fisher's	**Prob**			
Left	0.45			
Right	0.82			
2-tail	0.71			

Survey response score for each state using the five point scale.

Respondent Random ID	Overall total score	Respondent Random ID	Overall total score
JHKGF	12	GRCTN	6
YZSFP	-1	6LKPP	11
M4ABR	20	J4KCG	12
Y4CCC	12	4447J	14
NVGCK	7	A84TR	3
6T4ED	15	PFRHB	9
X4WA9	8	TTW3Y	14
JE3Z9	12	D563C	11
SMCHQ	4	6KM82	-5
QE2LG	14	2DQG2	14
R3FD9	6	XA57E	14
MMKAM	11	YQH24	12
DQ6B6	15	3X4CW	15
2AS7T	-3	682DZ	-2
FYXZB	3	DEQMR	11
S94W8	11	T2H3M	6
EQ6Q2	10	QFMBR	15
6UUUV	12	B3R76	15
V2GKW	19	X8X3L	12
G2V8C	11	8VT5G	20
A6XZL	12		
4AHAZ	15	**Total**	511
J96EM	13	**Average**	10.43
KML43	16		
NTHN7	6		
J7PLN	12		
TEJRG	8		
MBWQQ	14		
FDW4C	10		

Iteration History

Iter	LogLikelihood	Step	Delta-Criterion	Obj-Criterion
0	158.10575496	Initial	1102637.96	.
1	157.80227391	Newton	0.1897144	0.00192305
2	157.77743458	Newton	0.01372636	0.00015742
3	157.77736048	Newton	0.00004438	4.69667e-7
4	157.77736048	Newton	4.4921e-10	4.7355e-12

Whole Model

Number of Events	50
Number of Censorings	0
Total Number	50

Model	-LogLikelihood	ChiSquare	DF	Prob>Chisq
Difference	0.3284	0.6568	1	0.4177
Full	157.7774			
Reduced	158.1058			

Covariance of Estimates

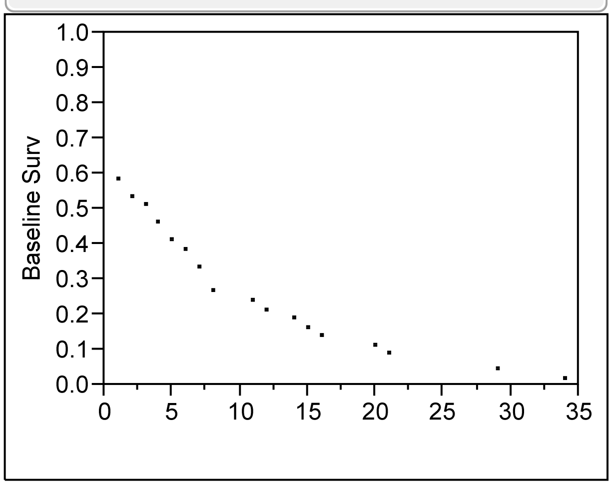
Cov

	X1= total aquaculture farms, continous
X1= total aquaculture farms, continous	0.0000

Effect Likelihood Ratio Tests

Source	Nparm	DF	L-R ChiSquare	Prob>ChiSq
X1= total aquaculture farms, continous	1	1	0.65678896	0.4177

Baseline Survival at mean



x axis: response time (days),

Parameter Estimates

Term	Estimate	Std Error	Lower 95%	Upper 95%
X1= total aquaculture farms, continous	0.00088115	0.0010116	-0.001483	0.0025746

Table

Time	Survival
34	0.0152412
29	0.0447033
21	0.0863231
20	0.1110257
16	0.136127
15	0.1615374
14	0.1871843
12	0.2130609
11	0.2389419
8	0.2648309
7	0.3356537
6	0.3850532
5	0.4107256
4	0.4607621
3	0.5102141
2	0.5356546
1	0.5856061

Survival Analysis: Proportional hazard fit of total aquaculture farms versus response time

Survival analysis of response time versus proportion of freshwater farms:

Iteration History

Iter	LogLikelihood	Step	Delta-Criterion	Obj-Criterion
0	158.10575496	Initial	268385690	.
1	157.90478629	Newton	0.04481482	0.00127264
2	157.90432796	Newton	8.80973e-5	2.90239e-6
3	157.90432796	Newton	3.1191e-10	1.0182e-11

Whole Model

Number of Events	50
Number of Censorings	0
Total Number	50

Model	-LogLikelihood	ChiSquare	DF	Prob>Chisq
Difference	0.2014	0.4029	1	0.5256
Full	157.9043			
Reduced	158.1058			

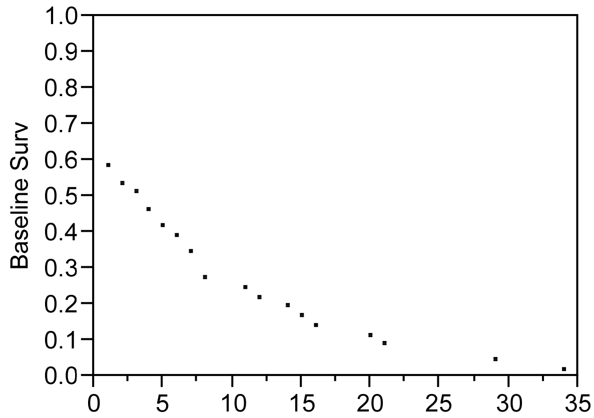
Parameter Estimates

Term	Estimate	Std Error	Lower 95%	Upper 95%
Proportion of freshwater farms	-0.2563354	0.3982575	-1.011163	0.5627365

Effect Likelihood Ratio Tests

Source	Nparm	DF	L-R ChiSquare	Prob>ChiSq
Proportion of freshwater farms	1	1	0.402854	0.5256

Baseline Survival at mean



Table

Time	Survival
34	0.0147244
29	0.0427002
21	0.0867677
20	0.113204
16	0.1400491
15	0.1660982
14	0.1924061
12	0.2189399
11	0.2449285
8	0.2710882
7	0.3421445
6	0.3909123
5	0.4157665
4	0.4637391
3	0.5114157
2	0.5359084
1	0.5840382

Survival analysis for saltwater farm proportion versus response time:

Iteration History

Iter	LogLikelihood	Step	Delta-Criterion	Obj-Criterion
0	158.10575496	Initial	318817218	.
1	157.85710838	Newton	0.06222976	0.00157504
2	157.85595193	Newton	0.00025132	7.32552e-6
3	157.85595191	Newton	3.61701e-9	1.0402e-10

Whole Model

Number of Events	50
Number of Censorings	0
Total Number	50

Model	-LogLikelihood	ChiSquare	DF	Prob>Chisq
Difference	0.2498	0.4996	1	0.4797
Full	157.8560			
Reduced	158.1058			

Parameter Estimates

Term	Estimate	Std Error	Lower 95%	Upper 95%
Proportion of saltwater farms	0.29890216	0.4146206	-0.56368	1.0764658

Covariance of Estimates

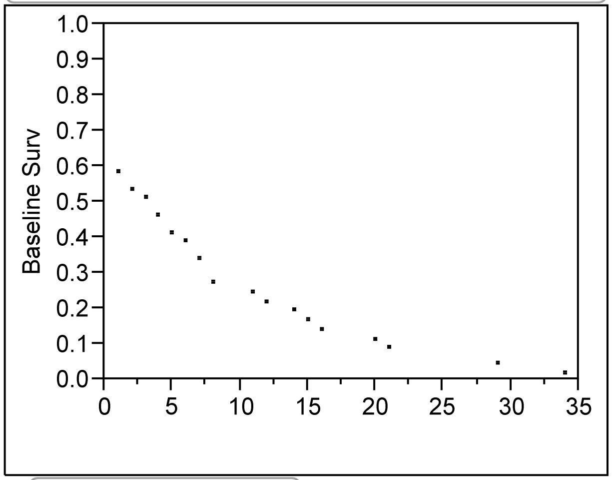
Cov

	Proportion of saltwater farms
Proportion of saltwater farms	0.1719

Effect Likelihood Ratio Tests

Source	Nparm	DF	L-R ChiSquare	Prob>ChiSq
Proportion of saltwater farms	1	1	0.49960608	0.4797

Baseline Survival at mean

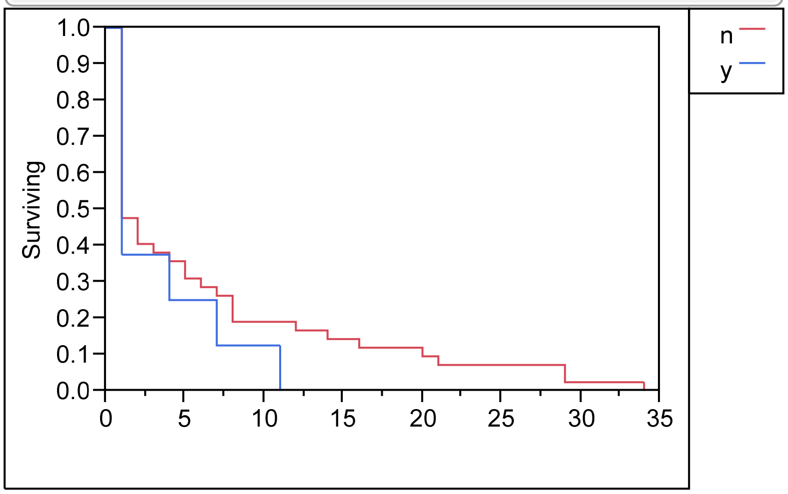


Table

Time	Survival
34	0.0147015
29	0.0427017
21	0.0868515
20	0.1133543
16	0.1402764
15	0.1660614
14	0.1921055
12	0.2183763
11	0.2439827
8	0.2697596
7	0.3396286
6	0.3884142
5	0.4137279
4	0.4624409
3	0.5107304
2	0.5355496
1	0.5843149

Survival analysis: proportional hazard fit of the difference of freshwater and saltwater proportion versus response time. (A) is the survival analysis for response time versus proportion of freshwater farms. (B) is the survival analysis for saltwater farm proportion versus response time:

Survival Plot



x axis: response time in days

Summary

Group	Number failed	Number censored	Mean	Std Error
n	42	0	6.11905	1.33922
y	8	0	3.375	1.33547
Combined	50	0	5.68	1.14978

Summary

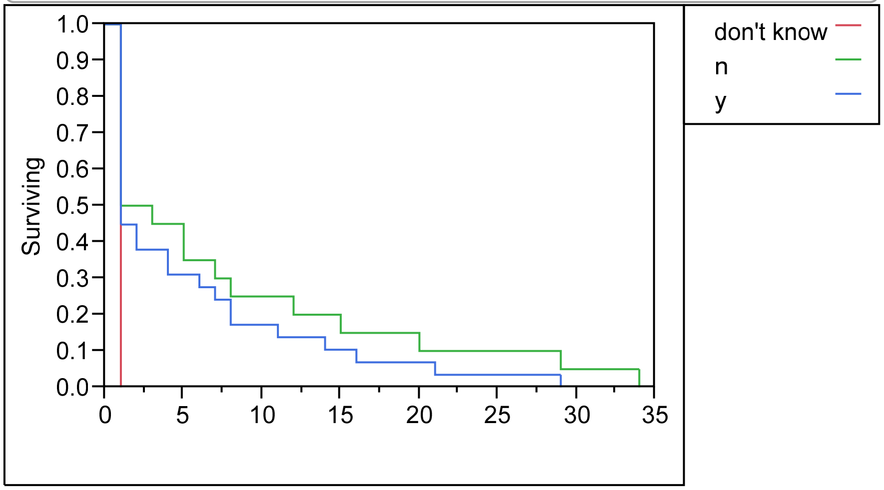
Group	Number failed	Number censored	Mean	Std Error
n	42	0	6.11905	1.33922
y	8	0	3.375	1.33547
Combined	50	0	5.68	1.14978

Tests Between Groups

Test	ChiSquare	DF	Prob>ChiSq
Log-Rank	1.0165	1	0.3133
Wilcoxon	0.4097	1	0.5221

Survival analysis comparing the 2 curves (states with KHV/SVC outbreaks versus states not having KHV/SVC in terms of response time)

Survival Plot



x axis: response time (days)

Summary

Group	Number failed	Number censored	Mean	Std Error
don't know	1	0	1	.
n	20	0	7.4	2.20812
y	29	0	5.10345	1.2983
Combined	50	0	5.94	1.16213

Quantiles

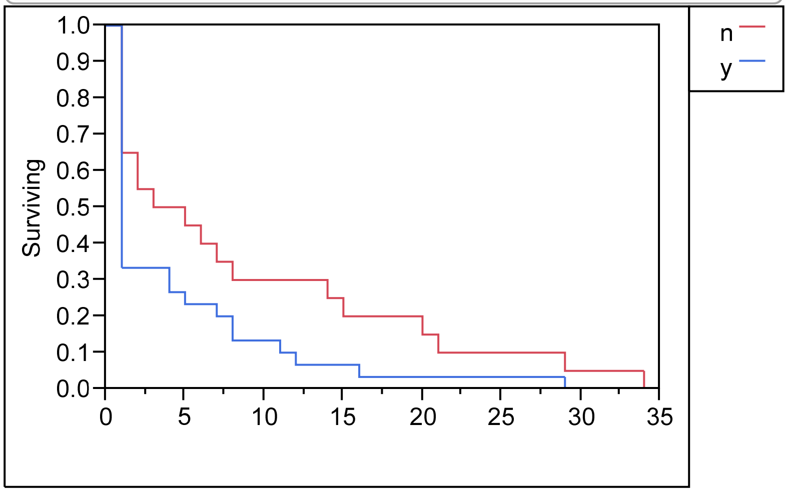
Group	Median Time	Lower 95%	Upper 95%	25% Failures	75% Failures
don't know	1	.	.	1	1
n	2	1	8	1	10
y	1	1	4	1	7
Combined	1	1	4	1	8

Tests Between Groups

Test	ChiSquare	DF	Prob>ChiSq
Log-Rank	1.7520	2	0.4164
Wilcoxon	1.2260	2	0.5417

Survival Analysis: comparing the curves (states reporting carp mortality events on the questionnaire versus states not reporting carp mortality events.

Survival Plot



x axis: response time in days

Summary

Group	Number failed	Number censored	Mean	Std Error
n	20	0	8.65	2.27142
y	30	0	4.13333	1.12621
Combined	50	0	5.94	1.16213

Quantiles

Group	Median Time	Lower 95%	Upper 95%	25% Failures	75% Failures
n	4	1	14	1	14.5
y	1	1	4	1	5
Combined	1	1	4	1	8

Tests Between Groups

Test	ChiSquare	DF	Prob>ChiSq
Log-Rank	3.3772	1	0.0661
Wilcoxon	4.3932	1	0.0361*

n

Response time numerical	Survival	Failure	SurvStdErr	Number failed	Number censored	At Risk
0.0000	1.0000	0.0000	0.0000	0	0	20
1.0000	0.6500	0.3500	0.1067	7	0	20
2.0000	0.5500	0.4500	0.1112	2	0	13
3.0000	0.5000	0.5000	0.1118	1	0	11
5.0000	0.4500	0.5500	0.1112	1	0	10
6.0000	0.4000	0.6000	0.1095	1	0	9
7.0000	0.3500	0.6500	0.1067	1	0	8
8.0000	0.3000	0.7000	0.1025	1	0	7
14.0000	0.2500	0.7500	0.0968	1	0	6
15.0000	0.2000	0.8000	0.0894	1	0	5
20.0000	0.1500	0.8500	0.0798	1	0	4
21.0000	0.1000	0.9000	0.0671	1	0	3
29.0000	0.0500	0.9500	0.0487	1	0	2
34.0000	0.0000	1.0000	0.0000	1	0	1

y

Response time numerical	Survival	Failure	SurvStdErr	Number failed	Number censored	At Risk
0.0000	1.0000	0.0000	0.0000	0	0	30
1.0000	0.3333	0.6667	0.0861	20	0	30
4.0000	0.2667	0.7333	0.0807	2	0	10
5.0000	0.2333	0.7667	0.0772	1	0	8
7.0000	0.2000	0.8000	0.0730	1	0	7
8.0000	0.1333	0.8667	0.0621	2	0	6
11.0000	0.1000	0.9000	0.0548	1	0	4
12.0000	0.0667	0.9333	0.0455	1	0	3
16.0000	0.0333	0.9667	0.0328	1	0	2
29.0000	0.0000	1.0000	0.0000	1	0	1

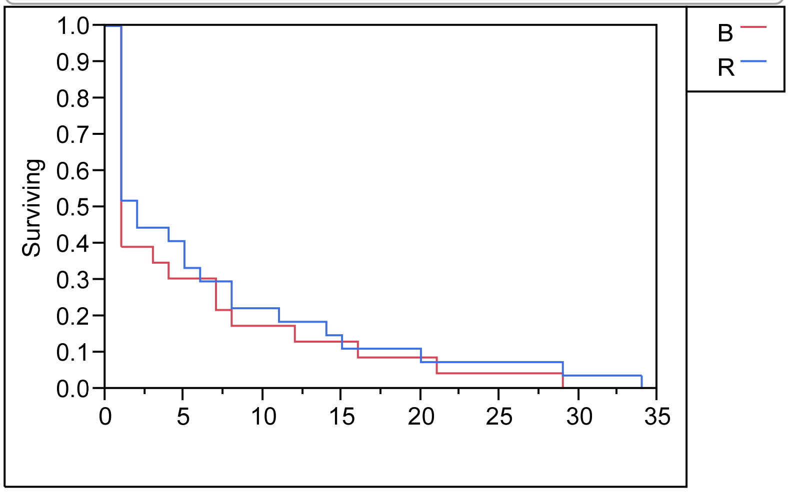
Combined

Response time numerical	Survival	Failure	SurvStdErr	Number failed	Number censored	At Risk
0.0000	1.0000	0.0000	0.0000	0	0	50
1.0000	0.4600	0.5400	0.0705	27	0	50
2.0000	0.4200	0.5800	0.0698	2	0	23
3.0000	0.4000	0.6000	0.0693	1	0	21
4.0000	0.3600	0.6400	0.0679	2	0	20
5.0000	0.3200	0.6800	0.0660	2	0	18
6.0000	0.3000	0.7000	0.0648	1	0	16
7.0000	0.2600	0.7400	0.0620	2	0	15
8.0000	0.2000	0.8000	0.0566	3	0	13
11.0000	0.1800	0.8200	0.0543	1	0	10
12.0000	0.1600	0.8400	0.0518	1	0	9
14.0000	0.1400	0.8600	0.0491	1	0	8
15.0000	0.1200	0.8800	0.0460	1	0	7
16.0000	0.1000	0.9000	0.0424	1	0	6
20.0000	0.0800	0.9200	0.0384	1	0	5
21.0000	0.0600	0.9400	0.0336	1	0	4
29.0000	0.0200	0.9800	0.0198	2	0	3
34.0000	0.0000	1.0000	0.0000	1	0	1

Survival Analysis: comparing the survival response time curves of states with coastline versus states without coastline, statistically significant (P <0.05).

A. *Survival analysis of red/blue states according to governorship 2007-2010 versus response time:*

Survival Plot



Summary

Group	Number failed	Number censored	Mean	Std Error
B	23	0	5.26087	1.56949
R	27	0	6.51852	1.70584
Combined	50	0	5.94	1.16213

Quantiles

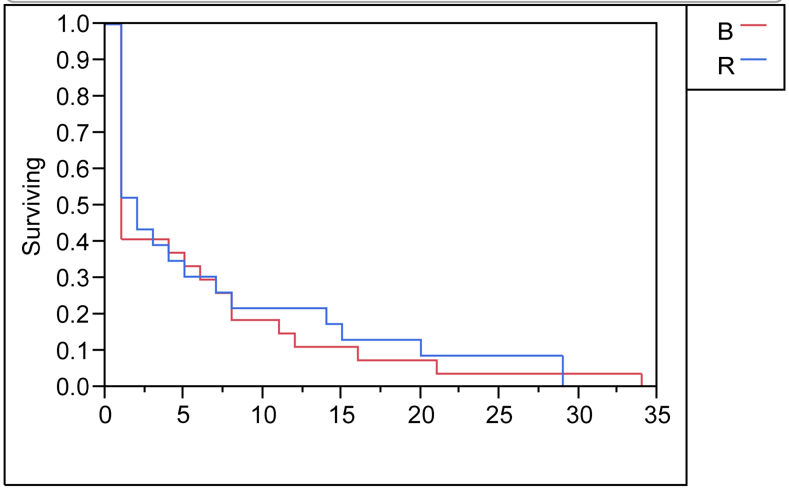
Group	Median Time	Lower 95%	Upper 95%	25% Failures	75% Failures
B	1	1	4	1	7
R	2	1	6	1	8
Combined	1	1	4	1	8

Tests Between Groups

Test	ChiSquare	DF	Prob>ChiSq
Log-Rank	0.3018	1	0.5828
Wilcoxon	0.5347	1	0.4647

B. Survival analysis for red/blue state according to presidential 2008 election versus response time

Survival Plot



x axis: response time in days

Summary

Group	Number failed	Number censored	Mean	Std Error
B	27	0	5.48148	1.49869
R	23	0	6.47826	1.84355
Combined	50	0	5.94	1.16213

Quantiles

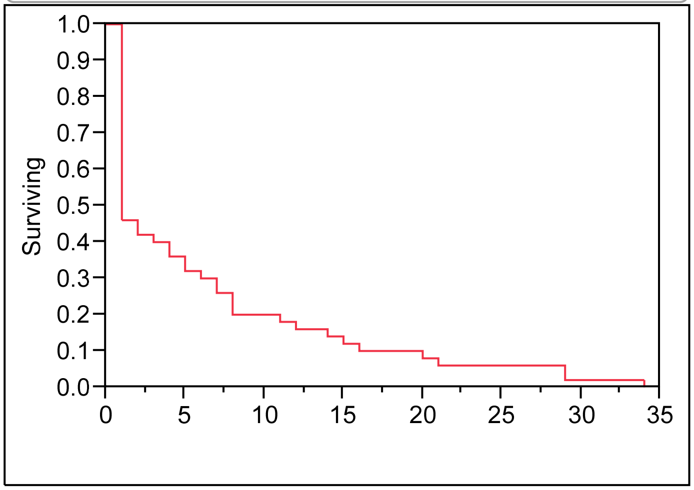
Group	Median Time	Lower 95%	Upper 95%	25% Failures	75% Failures
B	1	1	6	1	8
R	2	1	5	1	8
Combined	1	1	4	1	8

Tests Between Groups

Test	ChiSquare	DF	Prob>ChiSq
Log-Rank	0.0555	1	0.8138
Wilcoxon	0.2798	1	0.5968

Survival analysis: comparing political red versus blue states in terms of response time. Two sets of blue/red states (blue/red based on 2008 presidential election and blue/red based on 2007-2010 governorship). (A) survival analysis of red/blue states according to governoship 2007-2010 versus response time. (B) survival analysis for red/blue state according to presidential 2008 election versus response time.

Survival Plot



x axis is response time in days

Summary

Group	Number failed	Number censored	Mean	Std Error
Combined	50	0	5.94	1.16213

Quantiles

Group	Median Time	Lower 95%	Upper 95%	25% Failures	75% Failures

Combined

response time T (days	Survival	Failure	SurvStdErr	Number failed	Number censored	At Risk
0.0000	1.0000	0.0000	0.0000	0	0	50
1.0000	0.4600	0.5400	0.0705	27	0	50
2.0000	0.4200	0.5800	0.0698	2	0	23
3.0000	0.4000	0.6000	0.0693	1	0	21
4.0000	0.3600	0.6400	0.0679	2	0	20
5.0000	0.3200	0.6800	0.0660	2	0	18
6.0000	0.3000	0.7000	0.0648	1	0	16
7.0000	0.2600	0.7400	0.0620	2	0	15
8.0000	0.2000	0.8000	0.0566	3	0	13
11.0000	0.1800	0.8200	0.0543	1	0	10
12.0000	0.1600	0.8400	0.0518	1	0	9
14.0000	0.1400	0.8600	0.0491	1	0	8
15.0000	0.1200	0.8800	0.0460	1	0	7
16.0000	0.1000	0.9000	0.0424	1	0	6
20.0000	0.0800	0.9200	0.0384	1	0	5
21.0000	0.0600	0.9400	0.0336	1	0	4
29.0000	0.0200	0.9800	0.0198	2	0	3
34.0000	0.0000	1.0000	0.0000	1	0	1

Descriptive survival analysis of the response time

Statistical results of survey response scores versus variables

Linear Fit

Summary of Fit

RSquare	0.008959
RSquare Adj	-0.01213
Root Mean Square Error	144.1541
Mean of Response	87.53061
Observations (or Sum Wgts)	49

Lack Of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
				0.8975
Lack Of Fit	17	329274.35	19369.1	Prob > F
Pure Error	30	647404.67	21580.2	0.5824
Total Error	47	976679.02		Max RSq
				0.3431

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	8829.18	8829.2	0.4249
Error	47	976679.02	20780.4	Prob > F
C. Total	48	985508.20		0.5177

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	62.059129	44.17126	1.40	0.1666
overall total	2.442471	3.747107	0.65	0.5177

Statistical results of survey response score versus number of aquaculture farms.

Linear Fit

Summary of Fit

RSquare	0.011194
RSquare Adj	-0.00984
Root Mean Square Error	7.615711
Mean of Response	6.061224
Observations (or Sum Wgts)	49

Lack Of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack Of Fit	17	1385.9001	81.5235	1.8251
Pure Error	30	1340.0556	44.6685	**Prob > F**
Total Error	47	2725.9557		0.0729
				Max RSq
				0.5139

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	30.8607	30.8607	0.5321
Error	47	2725.9557	57.9991	**Prob > F**
C. Total	48	2756.8163		0.4693

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	4.5553227	2.333583	1.95	0.0569
overall total	0.1444015	0.197961	0.73	0.4693

Statistical results of survey response score versus number of sport aquaculture farms

Linear Fit

Summary of Fit

RSquare	0.032863
RSquare Adj	0.012285
Root Mean Square Error	18.93228
Mean of Response	7.163265
Observations (or Sum Wgts)	49

Lack Of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
				48.7109
Lack Of Fit	17	16257.297	956.312	Prob > F
Pure Error	30	588.972	19.632	<.0001*
Total Error	47	16846.269		Max RSq
				0.9662

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	572.425	572.425	1.5970
Error	47	16846.269	358.431	Prob > F
C. Total	48	17418.694		0.2126

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	13.648911	5.801172	2.35	0.0229*
overall total	-0.621911	0.492121	-1.26	0.2126

Statistical results of survey response score versus number ornamental aquaculture farms.

Linear Fit

Summary of Fit

RSquare	0.005386
RSquare Adj	-0.01578
Root Mean Square Error	2.980991
Mean of Response	1.959184
Observations (or Sum Wgts)	49

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	2.26179	2.26179	0.2545
Error	47	417.65658	8.88631	**Prob > F**
C. Total	48	419.91837		0.6163

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	1.551503	0.913426	1.70	0.0960
overall total	0.0390927	0.077487	0.50	0.6163

Statistical results of survey response score versus number of carp aquaculture farms

Linear Fit

Summary of Fit

RSquare	0.043418
RSquare Adj	0.023066
Root Mean Square Error	63.91629
Mean of Response	37.40816
Observations (or Sum Wgts)	49

Lack Of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
				4.5066
Lack Of Fit	17	137978.90	8116.41	**Prob > F**
Pure Error	30	54029.83	1800.99	0.0002*
Total Error	47	192008.73		**Max RSq**
				0.7308

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	8715.11	8715.11	2.1333
Error	47	192008.73	4085.29	**Prob > F**
C. Total	48	200723.84		0.1508

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	12.101765	19.58503	0.62	0.5396
overall total	2.4266409	1.661425	1.46	0.1508

Statistical results of survey response score versus number of food aquaculture farms.

Linear Fit

Summary of Fit

RSquare	0.001016
RSquare Adj	-0.02024
Root Mean Square Error	46.61298
Mean of Response	24
Observations (or Sum Wgts)	49

Lack Of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
				0.8297
Lack Of Fit	17	32659.45	1921.14	Prob > F
Pure Error	30	69460.72	2315.36	0.6503
Total Error	47	102120.17		Max RSq
				0.3205

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	103.83	103.83	0.0478
Error	47	102120.17	2172.77	Prob > F
C. Total	48	102224.00		0.8279

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	26.762162	14.28301	1.87	0.0672
overall total	-0.264865	1.211647	-0.22	0.8279

Statistical results of survey response score versus number of saltwater aquaculture farms.

Linear Fit

Summary of Fit

RSquare	0.015633
RSquare Adj	-0.00531
Root Mean Square Error	122.6163
Mean of Response	63.40816
Observations (or Sum Wgts)	49

Lack Of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
				0.9507
Lack Of Fit	17	247400.99	14553.0	Prob > F
Pure Error	30	459232.47	15307.7	0.5304
Total Error	47	706633.46		Max RSq
				0.3603

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	11222.38	11222.4	0.7464
Error	47	706633.46	15034.8	Prob > F
C. Total	48	717855.84		0.3920

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	34.69134	37.57171	0.92	0.3605
overall total	2.753668	3.187259	0.86	0.3920

Statistical results of survey response score versus number of freshwater aquaculture farms.

A. Survey response score versus proportion of freshwater

Linear Fit

Summary of Fit

RSquare	0.027297
RSquare Adj	0.006601
Root Mean Square Error	0.342473
Mean of Response	0.764856
Observations (or Sum Wgts)	49

Lack Of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack Of Fit	17	2.2969404	0.135114	1.2606
Pure Error	30	3.2155928	0.107186	**Prob > F**
Total Error	47	5.5125332		0.2815
				Max RSq
				0.4326

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.1546988	0.154699	1.3190
Error	47	5.5125332	0.117288	**Prob > F**
C. Total	48	5.6672319		0.2566

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	0.6582364	0.10494	6.27	<.0001*
overall total	0.0102238	0.008902	1.15	0.2566

B. Survey response score versus proportion of saltwater farms

Linear Fit

Summary of Fit

RSquare	0.046187
RSquare Adj	0.025893
Root Mean Square Error	0.322252
Mean of Response	0.214736
Observations (or Sum Wgts)	49

Lack Of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
				1.3026
Lack Of Fit	17	2.0727472	0.121926	**Prob > F**
Pure Error	30	2.8080202	0.093601	0.2561
Total Error	47	4.8807673		**Max RSq**
				0.4512

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.2363442	0.236344	2.2759
Error	47	4.8807673	0.103846	**Prob > F**
C. Total	48	5.1171116		0.1381

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	0.3465209	0.098743	3.51	0.0010*
overall total	-0.012637	0.008377	-1.51	0.1381

Statistical results of survey response score versus proportion of freshwater or saltwater aquaculture farms. (A). Survey response score versus proportion of freshwater. (B). Survey response score versus proportion of saltwater farms.

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Expected Score	Score Mean	(Mean-Mean0)/Std0
n	41	989.500	1025.00	24.1341	-0.953
y	8	235.500	200.000	29.4375	0.953

2-Sample Test, Normal Approximation

S	Z	Prob>|Z|
235.5	0.95258	0.3408

1-way Test, ChiSquare Approximation

ChiSquare	DF	Prob>ChiSq
0.9335	1	0.3340

Statistical results comparing survey response score between states with previous KHV/SVC outbreak versus states without KHV/SVC outbreaks.

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Expected Score	Score Mean	(Mean-Mean0)/Std0
don't know	1	16.500	25.000	16.5000	-0.569
n	19	486.500	475.000	25.6053	0.227
y	29	722.000	725.000	24.8966	-0.051

1-way Test, ChiSquare Approximation

ChiSquare	DF	Prob>ChiSq
0.3943	2	0.8211

Statistical results comparing survey response score between states with previous carp mortality events versus states without previous carp mortality events

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Expected Score	Score Mean	(Mean-Mean0)/Std0
n	19	474.500	475.000	24.9737	-0.000
y	30	750.500	750.000	25.0167	-0.000

2-Sample Test, Normal Approximation

S	Z	Prob>|Z|
474.5	-0.00000	1.0000

1-way Test, ChiSquare Approximation

ChiSquare	DF	Prob>ChiSq
0.0001	1	0.9918

Statistical results comparing survey response score between states with coastline versus states with no coastline.

A. *Survey response score versus red/blue state based on 2007-2010 governorship*

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Expected Score	Score Mean	(Mean-Mean0)/Std0
B	23	554.500	575.000	24.1087	-0.403
R	26	670.500	650.000	25.7885	0.403

2-Sample Test, Normal Approximation

S	Z	Prob>|Z|
554.5	-0.40313	0.6868

1-way Test, ChiSquare Approximation

ChiSquare	DF	Prob>ChiSq
0.1707	1	0.6795

B. *Survey response score versus red/blue state based on 2008 presidential election*

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Expected Score	Score Mean	(Mean-Mean0)/Std0
B	27	618.000	675.000	22.8889	-1.143
R	22	607.000	550.000	27.5909	1.143

2-Sample Test, Normal Approximation

S	Z	Prob>|Z|
607	1.14268	0.2532

1-way Test, ChiSquare Approximation

ChiSquare	DF	Prob>ChiSq
1.3289	1	0.2490

Survival analysis: comparing political red versus blue states in terms of survey response score. Two sets of blue/red states (blue/red based on 2008 presidential election and blue/red based on 2007-2010 governorship). (A). Survey response score versus red/blue state based on 2007-2010 governorship. (B). Survey response score versus red/blue state based on 2008 presidential election.

Linear Fit

Summary of Fit

RSquare	0.00806
RSquare Adj	-0.01304
Root Mean Square Error	5.588877
Mean of Response	10.42857
Observations (or Sum Wgts)	49

Lack Of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
				1.5507
Lack Of Fit	14	582.5524	41.6109	Prob > F
Pure Error	33	885.5185	26.8339	0.1473
Total Error	47	1468.0709		Max RSq
				0.4017

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	11.9291	11.9291	0.3819
Error	47	1468.0709	31.2356	Prob > F
C. Total	48	1480.0000		0.5396

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	10.078556	0.978901	10.30	<.0001*
response time T (days	0.0608183	0.098414	0.62	0.5396

Statistical results comparing survey response score versus response time

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Expected Score	Score Mean	(Mean-Mean0)/Std0
1	35	925.500	875.000	26.4429	1.113
2	7	129.500	175.000	18.5000	-1.294
3	4	85.000	100.000	21.2500	-0.533
4	3	85.000	75.000	28.3333	0.399

1-way Test, ChiSquare Approximation

ChiSquare	DF	Prob>ChiSq
2.2719	3	0.5179

Statistical results comparing survey response score of states with no reminders versus states after each reminder (1st, 2nd, and 3rd reminder). Group 1= survey response score of states that responded with no reminders, group 2 = survey response score of states that responded with one reminder, group 3= survey response score of states that responded with the second reminder, group 4 = survey response score of states that responded with the third reminder.

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Expected Score	Score Mean	(Mean-Mean0)/Std0
1	35	925.500	875.000	26.4429	1.113
2	7	129.500	175.000	18.5000	-1.294
3	7	170.000	175.000	24.2857	-0.129

1-way Test, ChiSquare Approximation

ChiSquare	DF	Prob>ChiSq
1.8455	2	0.3974

Statistical results comparing survey response score of states with no reminders versus states with one or more than 2 reminders. Group 1= survey response score of states that responded with no reminders, group 2 = survey response score of states that responded with one reminder, group 3 = survey response score of states that responded with the second and third reminder.