Environmental Risk Communication:

An Assessment of University Students’ Knowledge and Awareness about Fish Consumption Advisories

By

Kateland R. Grant

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Graduate Committee:

Linda R. Taylor, Chair
1. Introduction

1.1 Background & History of Environmental Risk Assessment

Risk is defined by the Environmental Protection Agency (EPA) as the chance of harmful effects to human health or ecological systems as a result of exposure to environmental stressors (EPA.gov). An environmental stressor is identified as any chemical, physical, or biological article that can produce an adverse response. Stressors can adversely affect an entire ecosystem, a natural resource, a biotic population, or even a single species. An assessment of such stressors is necessary in order to characterize the associated risk from stressor or hazard in the environment. The EPA has played a major role in the development of risk assessment methods (EPA.gov: http://www.epa.gov/riskassessment/basicinformation.htm).

The EPA was established in 1970, with the mission to “protect human health and the environment”. Risk assessments are conducted in support of this mission in order to identify the nature and level of the potential health risks to humans, and ecological receptors. Early on, the EPA participated in iterations of risk assessment processes, however the framework did not become formally defined until after the National Academy of Science (NAS) generated “Risk Assessment in the Federal Government: Managing the Process” in 1983. The EPA adopted key principles from the NAS report, and in the following year published Risk Assessment and Management: Framework for Decision Making (USEPA, 1984). This report highlighted the transparency of the risk assessment process, detailed its strengths and limitations, and provided alternatives within the assessment. Later, the EPA issued the current Agency-wide Risk Characterization Policy (USEPA, 1995a), for all risk assessments performed to include risk characterization, and standardize the process across the various programs in the agency. Over the past couple decades increased knowledge gains have been made: tools, guidences, and
policies have been developed, resulting in revisions to risk assessment principles and practices (EPA Staff Report, 2004).

The principles and practices vary based on the specific typology or hazard characterization being assessed. In general, risk is determined by three main factors: 1) how much of the article is in the environmental compartment (e.g., air, water, and soil), 2) how much a person, or ecological entity, has contact with the contaminated medium, and 3) and the intrinsic toxicity of the contaminant. Then, depending on the determined scope of the risk assessment, measurements are collected in order to identify the conditions and extent of the contamination present. Data are also used to model the fate and transport of the chemical, in efforts to predict the future behavior and movements of the contaminant. It is important to consider and assess not only the current risk, but the potential future risk to various human and/or ecological receptors. There are cases where a chemical might initially be categorized as low (risk), however, in the future the risk may be elevated to a higher category as time can contribute to the increased visibility of hazard (e.g., acute vs. chronic exposures to persistent or bio-accumulative compounds). In addition to risk characterization, assessments also include the interpretation of risk adversity, summarization of information confidence or reliability, and documentation of evidence supporting the risk characterization. A primary aim of risk assessments is to inform risk manager’s decision making process (EPA Staff Report, 2004).

1.2 Risk Management & Communication

Risk management evaluates how to approach the protection of human and environmental health. Managers have the capacity to implement action that work to mitigate and manage environmental risks. While management action is based partially on the findings of the risk
assessment, other important factors are considered. Management must consider a multitude of variables as they can affect action; for example, 1) economic factors (cost of the risk and risk mitigation alternatives), 2) laws and legal decisions (the framework that prohibits or requires action), 3) social factors (attributes of an individual or populations that may affect their susceptibility to a risk from a specified stressor), 4) technology factors (the availability, feasibility, impact, and range of risk management options), 5) political factors (interactions among and between different branches and levels of government and the citizens they represent), and 6) public factors (the attitudes and values of individuals and communities with respect to environmental quality, environmental risk, and risk management). Examples of actions taken by managers include: how much of a compound a company is allowed to discharge into a water body, deciding what substances can be stored as hazardous waste at a disposal facility, identify the extent of site cleaned up or remediation, set permit limits for discharge, storage, or transport, and determining national air or water quality standards – to name a few. Risk management often employs various communication tools in order to inform and advise the public of potential risks (EPA.gov: http://www.epa.gov/riskassessment/basicinformation.htm).

The risk communication process involves the exchange of information and opinions between risk assessors, risk managers, and other interested stakeholders. Ideally, the distribution of information between these groups should be maintained during the entire assessment process. In this case, the logic, scope, limitations, outcomes, and significance of the risk assessment are clearly understood by involved parties. This transparency practice can contribute to the level of trust between assessors, managers, and the public. Once managers evaluate, the employment of various communication tools can be used to inform and advise
the public of potential risks. Transmission of information between parties often include: 1) levels of health or environmental risks, 2) the significance or meaning of health or environmental risks, or 3) the decisions, actions, or policies aimed at managing or controlling health or environmental risks. Communication objectives vary depending on the inherent attributes of the risk. Types of communication functionalities include: enlightenment, right-to-know, attitude or behavioral change, risk reduction, emergency preparedness, or even public participation (Covello, vo Winterfeldt, and Slovic, 1986). Depending on the specific communication objective, communication tools are utilized; including the use of public databases, reports, advisories, pamphlets, and signage among others. For example, advisories can provide citizens access to comprehensive assessment summaries that highlight pertinent information. This allows individuals to make informed decisions about how they can reduce their exposure to the environmental hazard. This example illustrates the functionality of a risk reduction communication objective (Communicating Risk to the Public, R. Kasperson).

### 1.3 Risk Perception

Public perception of environmental hazards and the associated risk are of great importance with regards to policy development and hazard prioritization. There are cases where environmental hazards are identified as having a high level of risk, but low EPA effort. This disparity can be partially attributed to the influence of public opinion on the seriousness of environmental problem. For example, areas of high risk (as determined by risk assessors/experts), such as radon, indoor air pollution, stratospheric ozone depletion, and accidental releases of toxics, etc., received low priority ranking from the public, and resulted in low level of applied effort by the EPA. The reverse is also experienced - when low determined risk areas have conversely high designated effort levels. While this may seem
disproportionate in allocation of effort, there are some cases where this approach is not completely inappropriate. A multitude of factors, besides the determined risk, must be considered in setting priorities, but some hazards appear to pose relatively low risk precisely because of the high levels of effort and resources that have been contributing to assist in the control and management of the problem. It is important to examine the discrepancy of risk perception and priority ranking that exists between expert assessors and the public (EPA Staff Report, 2004).

1.2.1 Comparison of Expert and Public perceptions of Environmental Risk

The public perception of environmental risk is rarely proportional to that of experts. In a 1987 study, the US EPA compared experts’ rankings of important environmental risks with public risk perception (US Environmental Protection Agency 1987; Roberts, 1990). Little agreement was identified between the two groups of rankings. A study conducted in Sweden, compared the risk perception of experts and the public with regards to nuclear power. Drastic differences between group responses’ were identified. The distribution responses are displayed in the figure below (Figure 1).
Few experts judged the risk to be larger than “very small”, however, 65% of the public did judge the risk to be larger. This study provides an example of just one area of environmental risk that is perceived by the public, disproportionately to expert opinion (Sjöberg & Drottz-Sjöberg, 1994).

There are many theories that work to identify the reason(s) for the difference between expert and public judgment of risk. One set of factors involve background or demographic information, such as gender, education, or age, etc. However, there are other important variables to consider when exploring this phenomenon. Experts and the public might define risk differently. According to Sjöberg, experts tend to focus more on probability, while the public identifies more with consequences (Sjöberg, 1999b). The public could also be misinformed about problem particulars. This could be due to miscommunication or misinterpretation of risk information, among others. Typically, experts assess risk from a scientific perspective; they work to understand risk objectively. However, this impartial outlook does not necessarily
account to the variability within the expert group themselves, or the integration of values involved in the evaluation of risk. The socialization of values and risk perception in professional training or work settings can play a role. There can be conformity pressures; economic and career interests that influence an individual’s risk perception. Experts that are directly involved in an area probability perceive that they have control over its risks. In some cases, those who have lengthy experience can actually habituate them to these risks (familiarity). General political ideology can play a major role in how groups perceive risk, and can help explain some of the differences among groups. The public often rely on various forms media to inform them; newspapers, radio, and local/national news programs. The content of their messages about risk can influence public attitudes and what information they retain. The public must consume media critically, in order to identify if the source is presenting information driven by commercial or ideological strategies. There are also trust level differences between experts and the public. Experts are more likely to trust industry, agencies and other experts more than public. If the public does not trust the source(s) of the risk being identified, it can affect how seriously they will consider the problem. Credibility must be achieved in a community with a low level of trust in experts, authorities and media in order for perception differences to begin to equalize. The factors discussed briefly above are just some of many factors that can influence perception of risk. Nonetheless, investigating these factors can provide insight as to why such drastic differences exist between public and expert opinion (Sjöberg, 1999c).

1.3 Specific Environmental Case: Fish Consumption Advisories in the United States

A considerable amount of attention has been devoted over the past couple decades to the benefits of consuming fish, as well as the possible health risks. It is well documented that fish are an important source of protein, provide a major source of omega-3 fatty acids; which reduce
cholesterol levels, and the incidence of heart disease and stoke, increases cognitive function, and prevents low birth weight and pre-term delivery (Daviglus et al., 2002; Patterson, 2002). However, some fish contain chemicals that can pose health risk to humans. High Consumption amounts, of some species, with high contaminant levels, can cause adverse health effects, including counteracting the cardio-protective effects and damaging developing fetuses and young children (IOM, 1991). A decline in fecundity has been discovered, in women who consume large quantities of contaminated fish from Lake Ontario (Buck et al., 2000). Positive relationships have been identified between fish consumption by pregnant women, and deficits in neurobehavioral development in children, and between mercury and polychlorinated biphenyl (PCB) levels in fish (Guallar et al., 2002; IOM, 1991).

The United States have fish consumption advisories in place to protect their residents from the potential health risks of eating contaminated fish caught in local waters. Over the years, states have developed their own advisory programs, therefore, variability exists among the states with respect to scope, extend of monitoring, and the actual advice or guidelines they provide once contaminated species are found. National conclusions or identifying national trends in fish advisories is difficult to obtain due to the program variability. Advisories are not regulations, but rather offer recommendations to help inform citizens and protect public health. Consumption limits or recommendations of avoiding eating particular fish and other wild species caught from specific water bodies that are likely contaminated are typically included within the advisories. The advisories are a mechanism of risk communication.

An advisory may be issued for the general public, including recreational and subsistence fishers, or it may be issued specifically for sensitive populations, such as pregnant women, nursing mothers, and children. An advisory for a specific water body or water-body type may
cover more than one affected fish species or chemical contaminant. States are increasingly issuing statewide advisories to warn the public of the potential human health risks from chemical contamination of certain species of fish from all water bodies within the state. States are also continuing to issue safe eating guidelines to inform the public that fish from specific water bodies have been tested for chemical contaminants and that, based on those results, certain species of fish from those water bodies are safe to eat without consumption restrictions. State and local health departments typically issue the advisories, and in some cases, prohibiting by law, fishing in certain water bodies (Burger et al., 1999a). Typically, fish consumption guidences are also distributed with fishing licenses, or by postage placed near the water listing species of concern, usually with illustrations of these species. It has become more common, however, for information to be distributed in health clinics and doctors’ offices. The purpose of these efforts is for states to increase their monitoring activities, continue to grow the quantity of available information about fish contamination, with the ultimate objective being to better public health protection. However, changes in consumption behavior are dependent upon; 1) if people are aware of the advisements and benefits, and 2) how people perceive advisory information. From a risk management perspective, it is critical to understand how the target audience perceives the consumption advisory or other information provided to them. However, most agencies do not have the resources or opportunity to determine whether the target audience is receiving the intended message, and whether some aspects are actually understood (Burger J and Waishwell L, 2001).

In this paper, I examine the degree of knowledge and awareness of 1) fish advisories, 2) the risk and benefits of fish consumption, and identify fish consumption behavior among college students within a university community in central North Carolina (North Carolina State
University (NCSU)) in 2012. This brief study is intended to provide insight into the public perception of environmental risk. More specifically, to improve our understanding of what the university population knows about the risk and benefits of fish consumption, and help distinguish levels of knowledge about advisories.

2. Methods

2.1 Survey Procedure

A brief survey was distributed to students enrolled in the summer session semester at NCSU. Two university courses and students from a university wildlife and fisheries summer camp were included in the survey. The courses included 1) ES100: titled “Introduction to Environmental Science, a General Education Program (GEP) course that attracts a variety of students from science and non-science based curriculums, and 2) GIS 510, titled “Introduction to Geographic Information Sciences”, typically a graduate level course with more technically advanced students. I was particularly interested in examining the distribution of responses between science-based and non-science based students, and between male and female students.

The online survey was generated using a survey builder application, developed by the Academic and Administrative Technology department of NCSU. Students were required to provide login credentials to access the online survey application. This security measure was activated to ensure only university students would have access to the survey, and to allow only one submission per student. However, all responses were submitted anonymously, and no personally identifiable information was retained. Therefore, approval by the Institutional Review Board for the Protection of Human Subjects in Research (IRB) was not necessary. Faculty distributed the survey link to students via email. Students were informed prior to the
assessments and participation was anonymous, optional, and would in no way affect their grade in the class. The survey was available to students for a four week period during the first summer session of the 2012 summer semester, to be completed at their leisure.

2.1 Survey Questions

All questions were derived from reliable sources, primarily those identified in this paper’s introduction. The assessment was composed of fifteen questions total, with three different response types: ten multiple-choice, three select all that apply, and two short-answers (Appendix A). The survey questions fall into four basic categories: 1) demographic information (question numbers: 1, 2, 3, and 4), 2) awareness and knowledge of fish advisories (question numbers: 5, 6, 7, 13, and 15), 3) and knowledge about risks and benefits of fish consumption (question numbers: 10, 11, 12, and 14), and 4) fish consumption behaviors (question numbers: 8 and 9).

2.2 Data Analysis

Responses were submitted online, all survey responses were organized in an exportable MS Excel version that was generated by the Survey Builder application. Responses were tabulated from this original exported excel summary table so that answers of each respondent could be sorted by demographic factors. The survey results yielded an n=61. While this represents a small convenience sample, the intent of the study was to improve our understanding of what the university population knows about the risks and benefits of fish consumption, and fish advisories themselves. These data are not intended to validate this paper’s objectives, but rather, provide additional insight on the topic.
Based on the number of total respondents to the assessment, I calculated the precision of the assessment using a 95% confidence interval. A total of 61 respondents represent 0.55% of the total summer I semester population at NCSU (NCSU, 2011 enrollment data). To calculate precision for my given sample size of 61 respondents, an accuracy that answers to questions would be 50% correct, and a confidence level of 95%, this assessment has a confidence interval of 12.51%, considering the population number for summer session I 2011 enrollment at NCSU (n=11,039) (CRS, 2012).

3. Result

3.1 Demographics

The purpose of questions 1-4 of the survey (Appendix A) was to determine respondent demographics. Question 1 asked respondents to identify their college affiliation. Question 2 asked respondents to identify their gender. Question 3 asked the respondents to identify their academic year. Question 4 asked the respondent to identify if their degree was non-science based, science based, or if they were currently undecided. The composition of the survey population is illustrated in percentage by college affiliation (Figure 2), by academic year (Figure 3), by curriculum base (Figure 4), and by gender (Figure 5).
The College of Natural Resources (CNR) and the College of Engineering (ENG) make up approximately 45%, and 22% of the survey group respectively. While the College of Humanities & Social Sciences (CHASS), and the College of Agriculture & Life Sciences (CALS) account for about 12%, and 8% respectively. With the remaining 13% of respondents identified with the College of Education (EDU), Management (MGMT), Physics & Mathematical Science (PAMS), and Textiles (TEX). Distribution by academic year shows freshmen, sophomores, juniors, seniors, and graduate students represented by 3, 18, 34, 43, and 2%, respectively. Students from
a non-science based curriculum accounted for 12%, 85% identified science based, and 3% were undecided. For the gender distribution, females represented 37% of the respondents, and 63% were by males. It is clear that most of these distributions are unbalanced, and data may therefore be skewed. This imbalance is likely due, in part, to the sample population size (n=61). For the purpose of the subsequent category analyses, distribution of responses between 1) non-science based and science based students, and 2) males and females are compared.

3.2 General Knowledge about Fish Advisories

Question 5 (Appendix A) asked respondents to select the definition of fish advisories. Minimal difference in % correct between any of the compared groups was observed. Science-based and non-science based students answered correctly with 68%, and 71%, respectively. Males and females responded with 66% and 67% correct, respectively. Distributions displayed in the figure below (Figure 6).

![Figure 6: Percent of respondents per group that correctly defined fish advisories](image-url)
Question 6 (Appendix A) asks respondents to identify who issues fish consumption advisories (multiple choice). Typically, a state government agency or department issues fish advisories for an in-state advisory. However, the FDA, and EPA have issued fish consumption advisories in some cases. For science-based students, the most frequent response was “I don’t know” with 29%, and with State Government having the next most frequent with 25%. Non-Science based students most frequently selected the EPA, and State Government, with an equal response distribution of 29% for both. Male respondents responded State Government by 28%, and females selected the EPA and “Don’t know” with 36% each.

Table 1: Percentage response distribution of “who issues fish advisories” by group. Highest percentage response indicated by red circles for each group.

Question 7 (Appendix A) asked respondents to identify what department issues fish advisories in North Carolina. This question was a “fill in the blank” short answer type. Respondents were instructed to type in “I don’t know” if they did not know who issues the advisories. Only 25% of total respondents supplied a response other than “I don’t know”, of that 15%, only 1 respondent identified the correct department (i.e., Health Department) for the state.

Question 13 (Appendix A) asked respondents to identify what primary contaminants for which advisories are issued. The EPA identifies that most advisories involve five primary
contaminants: mercury, PCBs, chlordane, dioxins, and DDT. These contaminants are signified by an asterisk (*) symbol in the figures below (**Figure 7, and 8**).

**Figure 7:** Percent of response per curriculum based group by contaminant

**Figure 8:** Percent of response per gender based group by contaminant
The highest response rate for any contaminant was for mercury, for all groups. Response percentage range for mercury was 92-100%. Science-based students identified PCBs by 61%, and non-science based students identified 14%. Males and females responded by 62%, and 48%, respectively for PCBs. Chlordane was identified by science-based, non-science based, male, and female students by 22%, 0%, 18%, and 24%, respectively. Science-based respondents identified dioxins by 39%, while none of non-science based students identified dioxins as a primary contaminant. 28% of males and 43% of females identified dioxins. Identification of DDT as a primary contaminant was relatively similar across all groups, with a response range of 38-44%. Oil, sewage, and bacteria are not listed by the EPA as primary contaminants for fish advisories; however, these contaminants received a considerable range of response across the groups examined. Responses for these three non-primary contaminants range from 14-49%.

Question 15 asks respondents to identify for what contaminant are there currently fish advisories issued for Walnut Creek and Rocky Branch (located in Raleigh, NC – near the NCSU campus). Respondents were instructed to type in “I don’t know” if they did not know for what contaminant the advisories were issued (short answer). Approximately 77% of all respondents were unaware of what chemical the current local advisories were for, and answered “I don’t know”. Only 10% of all respondents correctly identified PCBs.

3.3 General Knowledge of the Risks & Benefits of Consuming Fish

Question 10 (Appendix A) asked respondents to identify which conditions Omega-3 fatty acids, from fish, reduce. Respondents were instructed to select “all that apply”. The figure below illustrates the percent per condition by group identified by respondents (Figure 9).
The reduction of cholesterol levels and incidence of stroke was represented by science-based, non-science based, male, and female students by 84%, 71%, 71%, and 81%, respectively. The reduction of incidence of heart disease also received high distribution of responses by all groups. Science-based and non-science based respondents identified with 76%, and 71%, respectively, while 63% of males, and 76% of females identified the reduction of incidence of heart disease. Pre-term delivery received relatively low levels of response across all groups compared to the other conditions. The percent that identified a reduction in pre-term delivery as a benefit of fish consumption ranged from 8-19%.

Questions 11 and 14 were multiple choice questions, with “True” or “False” as answer options. Question 11 (Appendix A) asked that respondents identify if some fish are worse in terms of contaminants than others. All respondents identified that some fish are worse in terms of contaminants than other, with the exception of one student. Question 14 (Appendix A) asked that respondents identify if some sub-populations are more sensitive than others. All respondents
identified that some sub-populations are more sensitive than others, with the exception of two students.

Question 12 (Appendix A) asked respondents to identify conditions that can be caused by contaminants in fish. The percent distribution of responses are illustrated for science-based and non-science based (Figure 10), and for males and females (Figure 11). The correct conditions are signified by an asterisk (*) symbol in the figures below.

Figure 10: Percent response of science-based students and non-science based students for conditions caused by contaminated fish.
Little variability was observed between group percentages for each condition. Most respondents identified the correct conditions with relatively high frequencies [39-86%]. The conditions of AIDS and Viruses are not caused by the consumption of contaminated fish. However, respondents from all groups examined here identified Viruses as caused by contaminated fish with a response range of 43-48%.

3.4 Fish Consumption Behavior

Question 8 (Appendix A) asked respondents how frequently they consume fish (multiple choice). Group weekly fish consumption is illustrated in the figure below (Figure 12).
The most frequently consumed quantity of fish consumed was 0-1X per week across groups. The percentage of respondents that consume fish 0-1X per week range from 57-77%.

Question 9 (Appendix A) asked respondents to identify the source of the fish they consume (multiple choice). Distributions of the source of fish consumed by respondents are illustrated in the figure below (Figure 13).
The majority of fish consumed by science-based, non-science based, male, and female students are either store-bought or purchased in restaurants. Science-based, male, and female respondents identified that they consume fish that are self-caught by 20%, 21%, and 14%, respectively.

4. Discussion

4.1 Study Limitations

The purpose of this study was to improve our understanding of what a university population knows about: 1) fish advisories, 2) the benefits or risks of fish consumption, and fish consumption behaviors of the population. The study population, however, was drawn from courses available during the summer semester, and a higher survey response rate was expected. The project was designed as a beginning step, in assessing the general knowledge and awareness of a population not typically targeted for risk communication. For example, several studies have been conducted that examine knowledge about fish consumption advisories target fishermen who
eat self-caught fish (Burger and Waishwell, 2001; Knuth et al., 2003). Future studies are recommended in order to broaden the subject pool to a larger geographic region, balanced for a number of demographic and educational factors.

4.2 Risks versus Benefits of fish consumption

There is a wealth of literature indicating the many health benefits of fish consumption, as well as the adverse effects, primarily due to contaminants (IOM, 1991). Fish consumption is a key example where consumers, must make risk balancing decisions (Burger, 2008). However, in order for people to make educated and advised decisions, they must first be aware of specific risks and benefits associated with fish consumption, and second, understand and retain the information provided. The figures below (Figure 14 & 15) provide a comparison between data collected in the present study and data collected in a study by Burger et al. in 2008. This research group interviewed people (n=174) in New Jersey, including college students and university employees. The figures illustrate similar percent distributions of respondents believing that the contaminants in fish cause specific adverse health effects.
Figure 14: Percent of respondents believing that the contaminants in fish cause specific adverse health effects (present study).

![Diagram](image)

**Do contaminants in fish cause the following?**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Percent</th>
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<tbody>
<tr>
<td>Cognitive problems</td>
<td>46%</td>
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<tr>
<td>Developmental defects</td>
<td>50%</td>
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<tr>
<td>AIDS</td>
<td>1%</td>
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<tr>
<td>Brain damage</td>
<td>37%</td>
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<tr>
<td>Birth defects</td>
<td>53%</td>
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<tr>
<td>Increased cancer rates</td>
<td>54%</td>
</tr>
<tr>
<td>Viruses</td>
<td>26%</td>
</tr>
<tr>
<td>Food poisoning</td>
<td>84%</td>
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Figure 15: Percent of respondents believing that the contaminants in fish cause specific adverse health effects (Burger J, 2008: p. 350, Fig. 5).

Both studies identified that more subjects thought contaminants in fish caused food poisoning than any other choices.

4.3 Risk Communication Implications

Information that might help risk communicators and risk managers includes: are people aware of advisories, do people know about the benefits or risks, do they know specific information about those benefits and risks, and is that information correct. Even with advisories being issued by every state in the U.S., there is often a gap in perception of risk by the fish-consuming public, and the agencies issuing the advisories. The public frequently view eating fish as posing less of a risk than the experts do (see subsection 1.2.1).
Overall, the majority of respondents correctly identified fish advisories as recommendations issued to help protect public health. Minimal differences were observed across respondent groups examined for this question. However, the majority of respondents were unaware of who actually issues fish advisories. Furthermore, only one single respondent could correctly identify the department that issues the advisories for the state of North Carolina.

Concerning specific knowledge about primary contaminants of which advisories are issued, Mercury yielded the highest distribution of responses from all groups examined, and overall. Mercury accounts for most of the fish advisories in the United States (EPA, 1989). Mercury can cause a multitude of adverse health effects - therefore, there is a large body of information provided in the literature, including technical and exposure reports, generated to inform the public, specifically, sensitive populations (e.g., pregnant/nursing women, young children) of health risks. The wealth of information available, in concert with heightened national media attention to mercury in fish, may explain the high levels of respondent awareness of mercury as a primary contaminant in comparison to others listed for the present study. However, in the case where overall 18% of respondent identified that they consume self-caught fish, only 10% were aware of the current fish advisories in the Raleigh area for PCBs. Indeed this it is alarming to consider that these respondents could be consuming contaminated fish because they are unaware of the existing advisories.

These observations may be useful for risk communicators to consider. My initial findings, in addition to similar scientific findings identified by others, discussed above, may indicate deficiencies in communication methods, information dispersion tools or mechanisms currently being utilized by the NC State Health Department. For any individual considering fish consumption, having access to clear risks and benefits information is critical (Burger J and
Waishwell L, 2001). While I am not suggesting that information on risks and benefits has not been made available various mechanisms, the findings indicate that perhaps the specific information may not be reaching a general audience, or the information is not being understood or retained properly. Additional assessments are recommended in order to 1) verify the extent of knowledge and awareness deficiencies concerning fish consumption advisories, and 2) identify communication tools that will be relevant to this university community.
References:


# Appendix A: Online Fish Advisory Survey Questions

**Fish Advisory Survey**

This is submission 1 (1 allowed)
This submission is anonymous

<table>
<thead>
<tr>
<th>1. What is your college?</th>
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<tbody>
<tr>
<td>College of Agriculture &amp; Life Sciences (CALS)</td>
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<tr>
<td>College of Design</td>
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<td>College of Education</td>
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<tr>
<td>College of Engineering</td>
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<tr>
<td>College of Humanities &amp; Social Sciences (CHASS)</td>
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<td>Poole College of Management</td>
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<td>College of Natural Resources (CNR)</td>
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<tr>
<td>College of Physical &amp; Mathematical Sciences (PAMS)</td>
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<td>College of Textiles</td>
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<td>First-Year College (FYC)</td>
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<tr>
<th>2. What is your gender?</th>
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<tr>
<td>Male</td>
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<td>Female</td>
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<th>3. What is your degree base?</th>
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<tr>
<td>science-based</td>
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<td>non-science based</td>
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<tr>
<td>undecided</td>
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<th>4. What year are you?</th>
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<tr>
<td>Freshman</td>
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<td>Sophomore</td>
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<td>Junior</td>
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<tr>
<td>Senior</td>
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<tr>
<td>Graduate Student</td>
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<th>5. What are fish advisories?</th>
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<tr>
<td>A fish consumption advisory is a regulation issued to help protect public health. These advisories include regulations to limit or avoid eating certain species of fish caught from specific water bodies or from water-body types (e.g., lakes, rivers or coastal waters) due to chemical or parasite contamination.</td>
</tr>
<tr>
<td>A fish consumption advisory is a recommendation issued to help protect public health. These advisories may include recommendations to limit or avoid eating certain species of fish caught from specific water bodies or from water-body types (e.g., lakes, rivers or coastal waters) due to chemical contamination.</td>
</tr>
</tbody>
</table>
6. Who issues fish consumption advisories?
- FDA
- EPA
- State Governments
- Fish & Game Department
- I don’t know

7. What department issues fish advisories in North Carolina? (If you do not know, type "I don’t know" in response field)

8. How frequently do you consume fish?
- 0–1 X per week
- 1–2 X per week
- 2–4 X per week
- 5+ X per week

9. When you consume fish, where does the fish come from?
- Store-bought
- Restaurants
- Self-caught
- Other
- I don’t know

10. Fish provide Omega-3 fatty acids that reduce ________ (select all that apply).
- cholesterol levels and incidence of stroke
- incidence of heart disease
- pre-term delivery
- I don’t know

11. Some fish worse in terms of contaminants than others?
- True
- False
12. Contaminants in fish cause the following (select all that apply).

- Cognitive problems
- Developmental defects
- AIDS
- Brain damage
- Birth defects
- Increase cancer rates
- Viruses
- Food poisoning

13. For what primary contaminants are the advisories issued? Select all that apply.

- Mercury
- PCBs
- Chlordane
- Dioxins
- DDT
- Oil
- Sewage
- Bacteria

14. Some sub-populations are more sensitive to contaminants than others.

- True
- False

15. Currently, there are ACTIVE advisories for Walnut Creek and Rocky Branch (located in Raleigh, NC - near the NCSU campus). What contaminant are these advisories for? (If you do not know, type "I don't know" in response field)

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

Fish Advisory Survey

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

Submit

This is submission 1 (1 allowed)
This submission is anonymous

Please contact the owner, krgrant@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 calx_webapp@ncsu.edu
Help desk hours: M-F, 8 am - 5 pm EST