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UNDERSTANDING MID-ATLANTIC RESIDENTS' CONCERNS, ATTITUDES, AND PERCEPTIONS ABOUT HARMFUL ALGAL BLOOMS: *PFIESTERIA PISCICIDA*

Sea Grant
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by

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EXECUTIVE SUMMARY

BACKGROUND

More than 4,400 species of microscopic algae comprise the marine phytoplankton base of the marine food chain. Without them life on Earth could not exist. Of these, only about 60 species are toxin producers (a mere 1.3%). The number known to be toxic has increased since 1984, when only 22 harmful species had been identified. Most of these toxic species belong to a group of microscopic algae called dinoflagellates.

In 1991, *Pfiesteria piscicida* became the newest toxic dinoflagellate to draw national attention. The word *piscicida* is Latin for "fish killer." It is a single-celled, microscopic organism (thousands of these little creatures would fit on the head of a pin) with two flagella for locomotion and can be found in both bottom sediments and the water column. It has been identified from the Gulf of Mexico to a tidal river in New Jersey and is the leading suspect for many large fish kills throughout the mid-Atlantic region, most notably in North Carolina estuarine waters (in the mid-1990s) and tributaries of the Chesapeake Bay (in 1997 and 1998).

The risks that *Pfiesteria* poses to human health are not fully understood. *Pfiesteria* is not an agent of infectious or contagious disease--it cannot be caught like a cold virus. There is no conclusive evidence it can be passed along in the food chain or passed from fish to humans through consumption. Human health effects, so far, seem linked to exposure to water that contains the toxin and not to eating seafood. Skin lesions and sores have been reported in humans as well as more critical symptoms including narcosis (a drugged effect), severe headaches, flu-like symptoms, acute loss of short-term memory, respiratory problems, and impaired liver and kidney function.

METHODS

A mail survey effort was determined to be the most effective method of obtaining information from regional residents on their perceptions of *Pfiesteria*. In addition to a mail questionnaire, appropriate cover letters explaining the intent of the survey and a postcard reminder were designed for this project (See Appendix A). Six states within the Mid-Atlantic region were originally targeted as sampling states (North Carolina, Virginia, Maryland, Delaware, New Jersey, and New York). At the time the survey instrument was first mailed (November 1998), the four states from North Carolina to Delaware had experienced toxic *Pfiesteria* outbreaks or had nontoxic forms of the organism identified in water samples taken from state tidal waters.

Residents of these four states were sampled using a two-part stratification. A statewide sample (N=600) and a coastal sample (N=200) were selected for each of these states. The coastal sample was selected by identifying counties within the four states that were coastal or tidal in nature.

The initial mailings were sent during the fall of 1998. Approximately 3,172 surveys (including cover letters and postage-paid return mail envelopes) were distributed to residents in the four states. If responses were not received from the targeted sample within seven to 10 days, a follow-up postcard reminder was mailed. Approximately two weeks after the initial mailing, a follow-up survey instrument, along with a revised cover letter and postage-paid

return envelope, was re-sent to those residents who had still not returned a completed questionnaire.

Of the 3,372 residents who were mailed a copy of the survey instrument, 561 mailings were returned undeliverable by the U.S. Postal Service due to incorrect addresses or other reasons, thus leaving an effective sample size of 2,811. Seven hundred forty-nine completed questionnaires were received for an overall response rate of 27%.

STUDY RESULTS

Socioeconomic Characteristics

Overall, 44% of respondents were college graduates, with little difference observed among the states (between 42% and 45%). The age distribution of respondents was well-dispersed. Twenty percent were under 40 years of age, 44% were between the ages of 40 and 59 years, and 37% were 60 years of age or greater. Males were twice as likely to respond to the survey than females and one-third of the respondents were retired.

Beach Visitation and Activities

Overall, 89% of study respondents visited beaches in the Mid-Atlantic region. As expected, most respondents tended to visit beaches within their state of residence or a neighboring state. Visitors to coastal areas participated in many different activities, ranging from swimming and enjoying the beaches to visiting nature areas along the coast. Overall, swimming and other beach-related activities (78%) and eating at seafood restaurants (78%) were the two most popular activities of coastal visitors. Forty-nine percent of all respondents visited nature areas and 42% indicated that they bought local seafood.

Rating the Importance of Coastal Problems

Respondents were provided with a list of 10 problems that could affect coastal areas across the country to varying degrees. Survey recipients were instructed to rate the problems on a 5-point scale (1 = Least Serious and 5 = Most Serious). Overall, seven of the 10 problems were rated as fairly serious, with mean ratings between 4.3 (water pollution) and 3.8 (*Pfiesteria*, shoreline erosion, and coastal population growth). The three lowest rated problems (red or brown tides, dredging, and rising sea level) received neutral ratings, with mean ratings between 3.4 and 2.9.

The Public's Understanding of *Pfiesteria*

Ninety-three percent of the study sample reported that they had heard of *Pfiesteria*. When those who had heard of it were asked to describe what they thought it was, there were a variety of responses offered. Respondents were provided five selections and were instructed to select only one response. Four responses were almost equally divided among all of the respondents: a form of pollution (23%), a disease in fish (22%), a parasite in fish (22%), and a toxin or poison (21%). The response, "a predator that attacks fish," was selected by only 5% of the study subjects.

Harmful Nature of *Pfiesteria*

Limited scientific information suggests that *Pfiesteria* can be harmful to humans. Overall, 95% of the study sample indicated that they thought the organism could be harmful to humans. When asked to indicate how they thought it could be harmful, two-thirds (66%) reported that it harms the environment which can indirectly harm people, 64% were concerned that it could harm people through eating seafood, 54% thought that swimmers or those wading in the water could be harmed, and 47%

indicated that they thought fishermen in boats could be harmed if they touched fish or water during a toxic outbreak. Very few people (3%) believed that the organism could emit aerosols into the air and harm people.

Conditions Contributing to *Pfiesteria*

Survey recipients were asked to rank the conditions that they felt contributed to *Pfiesteria* blooms in their state by selecting their top three choices from a listing of possible conditions. Individuals were then requested to rank their three most important conditions. Twenty-four percent of all respondents thought livestock farming practices contributed to *Pfiesteria* blooms. This was followed by pollution from factories and industry (20%) and stormwater drainage or sewage plant discharges (19%).

Concerns about *Pfiesteria*

The study participants were asked to identify what concerned them the most about *Pfiesteria*. They were provided with six responses and were asked to select their three most important concerns. They could also contribute their own responses. Overall, the respondents were most concerned about the health of marine animals (23%). The next highest rated concern was that *Pfiesteria* indicates too much pollution is going into waterways. Overall, 22% of the sample mentioned this as an important concern.

Statements about *Pfiesteria*

Survey respondents were provided with a series of eight statements about *Pfiesteria* and asked to agree or disagree with the statements. A 5-point scale was used with 1 = Strongly Disagree and 5 = Strongly Agree. Mean scores are reported, along with the percentage of respondents who "agreed" or "strongly agreed" with the statement. The highest rated statement overall, with 85% of residents either "agreeing" or "strongly agreeing," was that money being spent by their state government to understand and help correct problems caused by *Pfiesteria* is a good investment for their state's future. The statement received a mean rating score of 4.1 on the 5-point scale. The next highest rated statement, with 64% "agreeing/ strongly agreeing," was that agricultural runoff can cause *Pfiesteria* outbreaks (3.7 mean rating). Overall, only about one-third (32%) of the respondents "agreed/strongly agreed" that they had enough knowledge about *Pfiesteria* to make informed decisions that may affect them (2.8 mean rating). Forty-one percent overall "agreed/strongly agreed" that if public health and environmental officials said it was safe to return to the water where a *Pfiesteria* outbreak had occurred, they would trust their judgement (3.1 mean rating). Twenty-eight percent "agreed/strongly agreed" with the statement that science, not politics, forms the basis for decisions that are made in their state about *Pfiesteria* (2.9 mean rating). Only ten percent of respondents "agreed/strongly agreed" that *Pfiesteria* occurs naturally in the marine environment with humans having little or no control over the outbreaks (2.1 mean rating).

***Pfiesteria* Awareness**

The study respondents were asked if they were aware of *Pfiesteria* outbreaks in their respective states. The two states which have had the greatest number of outbreaks and major fish kills, Maryland (95%) and North Carolina (89%), generated the greatest level of awareness from respondents. Residents in the states of Delaware (60%) and Virginia (71%) indicated significantly lower levels of awareness.

As a follow-up, survey recipients who indicated they were aware of outbreaks were asked if they thought their state government officials had responded adequately during toxic

outbreaks. Overall, about one-third (35%) of all respondents felt officials responded adequately.

Contact with Officials

In order to gauge how active citizens are about communicating with state officials regarding *Pfiesteria* concerns, residents were specifically asked if they had contacted elected officials or state agency personnel to discuss concerns related to *Pfiesteria*. Overall, only 3% of residents indicated that they had contacted either of these types of individuals. When individuals were asked if they had ever attended a public meeting or public hearing about *Pfiesteria* issues, 5% of residents overall reported attending a meeting.

Effects of *Pfiesteria* on Travel

Respondents were asked to answer a question of whether a *Pfiesteria* outbreak would affect their travel plans. Overall, about one-third (32%) of the respondents indicated that they would still visit a coastal area if an outbreak occurred, but would change some of the activities that they had planned if there were an outbreak. Twenty-nine percent of respondents indicated that they would go to another coastal area unaffected by *Pfiesteria*.

***Pfiesteria* and Seafood Safety**

When the study participants were questioned about whether they had heard reports that seafood was unsafe to eat because of *Pfiesteria* outbreaks, 63% responded they had heard such reports, 14% responded that they were "unsure," and about one-quarter (23%) indicated they had not heard any reports. Those who responded in the affirmative were further asked if they thought it was safe to eat seafood from an area where an outbreak had occurred if it were properly handled and prepared. Only 24% responded "yes," 45% responded "no," and 31% responded that they were "unsure".

Those individuals who indicated they eat seafood were asked whether they had changed or would change their eating habits because of *Pfiesteria* concerns. To obtain answers to this question, they were asked whether they generally knew the area where their seafood was caught. Of those respondents who ate seafood, about one-third (31%) responded that they generally knew where their fish was caught, 12% responded they were "unsure," and slightly more than one-half (51%) responded that they did not know where their fish was caught. Only 6% of the respondents indicated they did not eat seafood.

The respondents who replied they did eat seafood were asked if they had avoided buying or eating seafood from restaurants or markets within the previous five years based on information they had heard about *Pfiesteria*. Only 20% of respondents overall indicated that they had avoided buying or eating seafood during that time period. A follow-up question asked seafood eaters whether a *Pfiesteria* outbreak in their state would cause them to reduce their consumption of seafood from their state's waters. Fifty-eight percent responded that they would reduce their consumption, 23% responded that they were unsure how they would react, and less than one-fifth (19%) reported that they would not reduce their consumption of state-harvested seafood because of a *Pfiesteria* outbreak

Awareness of Other Marine Toxins

When the study subjects were asked if they were aware of other toxins, bacteria, viruses, or organisms in ocean and bay waters that might be harmful to marine life, 42% indicated they were aware of some. These

included things such as red or brown tides, oyster parasites, algae, and phosphates.

Information Sources for Learning about Environmental Matters

When asked to report which sources of information they used regularly to learn about environmental issues affecting their respective states, television (90%) and newspapers (89%) were reported the most often. Listening to the radio (51%) was the only other source mentioned by more than one-half of the respondents. Magazines (37%), family/friends/ co-workers (31%), and environmental groups (21%) were used to a lesser degree to learn about environmental issues. Only 9% of the respondents mentioned that internet web sites provided them with regular environmental information, even though 54% reported that they had access to internet web sites from a home or office computer.

Study subjects were further requested to indicate if they would use other sources of information if their regular information sources were not sufficient. Environmental organizations, public libraries, internet web sites, and state government officials each received between one-half and one-third of the responses from study subjects overall. University scientists (29%), local fishermen (28%), and university extension personnel (27%) all received a fairly consistent level of support.

Access to the Internet

More than one-half of all respondents (54%) reported that they had access to internet web sites for information (either at home or through their work). Only 31% of the respondents overall indicated that they thought computers were "very" or "extremely" important for finding information on environmental topics.

Conclusions

The findings presented in this report clearly demonstrates that *Pfiesteria* is well known to Mid-Atlantic residents and their behavior following a toxic outbreak may have a significant impact on coastal communities. Additionally, the survey results suggest a need to make additional information readily available to all audiences. While this survey focused on the harmful algal bloom, *Pfiesteria piscicida*, the lessons learned could be applied more generally to other important issues and problems affecting coastal areas.

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ACKNOWLEDGMENTS

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Finally, we would like to thank all of the residents in the Mid-Atlantic region who took the time to respond to our survey. Their responses should help resource managers, public health officials, and elected officials better appreciate and understand the public's concerns about harmful algal blooms, in particular *Pfiesteria piscicida*.

UNDERSTANDING MID-ATLANTIC RESIDENTS' CONCERNS, ATTITUDES, AND PERCEPTIONS ABOUT HARMFUL ALGAL BLOOMS: *PFIESTERIA PISCICIDA*

INTRODUCTION

The results presented in this report represent one component of a Mid-Atlantic Sea Grant response to the impact of *Pfiesteria piscicida* throughout the region. Other components of the project included, documentary videos, radio public service announcements, an educational resource guide, and an assessment of the economic ramifications of *Pfiesteria* throughout the region. The intent of this specific element of the regional project was to assess the general public's concerns, perceptions, and attitudes about the organism and to better understand how they might react to a toxic *Pfiesteria* event. Prior to this study, limited information was available to describe the general public's impressions of this organism. The report presents information from residents in each of four Mid-Atlantic states (Delaware, Maryland, Virginia, and North Carolina) and from residents living in two distinct geographic regions within the states--inland and coastal. Responses based on these subgroup distinctions are important to state decision makers and public sector officials in managing *Pfiesteria* within their respective states. The specific objectives associated with this study include the following:

- Determining to what extent residents of the region are aware of *Pfiesteria* and whether they can associate this organism with other known "cultural models"[1]
- Gauging whether residents feel that *Pfiesteria* can be harmful to humans and to what extent
- Identifying how residents think *Pfiesteria* impacts the environment and themselves personally
- Determining whether residents have an understanding of the causes of *Pfiesteria*
- Determining whether residents think there is reason for concern about *Pfiesteria* and the seafood they eat

[1] A cultural model is a simplified way of understanding a complex system shared by members of a culture. People organize their beliefs and values using cultural models. Since *Pfiesteria* is a new phenomenon impacting coastal waters, it is useful to determine if residents can relate the organism to any other known entity.

- Gauging residents' perceptions of how government agencies have responded to *Pfiesteria* outbreaks
- Understanding how residents obtain information on environmental issues such as *Pfiesteria*

By better understanding how the residents of the Mid-Atlantic region perceive this organism and its effects, Sea Grant educators and communicators, public sector officials, and others can more effectively target factual, objective information about the organism to concerned audiences. Responses can also provide resource managers and public health officials with a clearer picture of how residents perceive the risks associated with a toxic *Pfiesteria* outbreak. This information may be useful in developing risk communication messages directed to those individuals who may be impacted.

BACKGROUND

Harmful Algal Blooms

More than 4,400 species of microscopic algae comprise the marine phytoplankton base of the marine food chain. Without them, life on Earth could not exist. Of these, only about 60 species are toxin producers (a mere 1.3%). The number known to be toxic has increased since 1984, when only 22 harmful species had been identified. Most of these toxic species belong to a group of microscopic algae called dinoflagellates.

Toxic algae have been around for thousands of years, but scientists suggest that human activities near the coast are probably making them worse. Before the 1970s, only a few regions of the United States were affected; now toxic algal blooms are a significant and recurring problem stretching from the Gulf of Maine to the Gulf of Alaska. In many areas, blooms are increasing in frequency. While the scientific community is divided about precisely what is causing many of the outbreaks, there is consensus that they generally occur in places where water circulation is poor and the water is rich in nutrients, usually from sewage, animal wastes, or fertilizer-laden runoff.

Algal blooms occur when algae photosynthesize and multiply rapidly by converting dissolved nutrients and sunlight. Some algal blooms may prove lethal to marine life as the sudden abundance of algae depletes the oxygen that fish need to survive. However, most naturally occurring blooms are vital and beneficial to the marine food chain. Small numbers of virtually invisible toxic algal species may be present in coastal waters at any time. In the right environment they can form large colonies or blooms that pose harm to fish, shellfish, marine mammals, and humans.

Marine ecologists see the increase of harmful algal blooms as part of a complex global epidemic. Pumping of bilge waters by ships carrying species from one ocean area to another, currents and surface winds bringing nutrients from deeper waters, and overfishing of clams, oysters, and other filter-feeding shellfish that feed on algae all add to the problem. Many of the toxins produced by these blooms are both waterborne and airborne, increasing the opportunities for human exposure. Outbreaks can also cause millions of dollars in economic losses to coastal communities.

Pfiesteria piscicida

In 1991, *Pfiesteria piscicida* became the newest toxic dinoflagellate to draw national attention. The word *piscicida* is Latin for "fish killer." It is a single-celled, microscopic organism (thousands of these little creatures would fit on the head of a pin) with two flagella for locomotion and can be found in both bottom sediments and the water column. It has been identified from the Gulf of Mexico to a tidal river in New Jersey and is the leading suspect for many large fish kills throughout the Mid-Atlantic region, most notably in North Carolina estuarine waters (in the mid-1990s) and tributaries of the Chesapeake Bay (in 1997 and 1998). It is a primitive life form capable of assuming both animal and plant characteristics in its more than two dozen life stages, perhaps transforming between stages when certain environmental conditions and food sources are available. Of the 24 life stages identified so far for *Pfiesteria*, at least four have been shown to be toxic.[2] As a dinoflagellate algae, it is neither a virus, bacterium, nor an infectious agent. Fish or other organisms cannot become infected with *Pfiesteria*.

Like other toxic algae, scientists agree that *Pfiesteria* has been present in Atlantic and Gulf waters for thousands of years, but the ecological balance has been such that it has been naturally kept in check. For much of the year, the various life forms of *Pfiesteria* are harmless members of the food chain that survive by eating bacteria, algae, and small organisms. However, under certain circumstances that are not fully understood, and seemingly only in the presence of live fish, *Pfiesteria* can alter its life form and begin releasing a toxin that can cause lesions on fish and sloughing of the surface layer of fish skin. In high concentrations, the *Pfiesteria* toxin can kill fish within minutes. Within hours after the fish die or move on, or other conditions change, the *Pfiesteria* form protective outer coverings and drop to the bottom sediment as dormant cysts. Because menhaden school in large groups and may be more sensitive to *Pfiesteria's* toxins than other fish, they are often the species seen in major fish kills.

The risks that *Pfiesteria* poses to human health are not fully understood. *Pfiesteria* is not an agent of infectious or contagious disease--it cannot be caught like a cold virus. There is no conclusive evidence it can be passed along in the food chain or passed from fish to humans through consumption. Human health effects, so far, seem linked to exposure to water that contains the toxin and not to eating seafood. Skin lesions and sores have been reported in humans as well as more critical symptoms

[2] A second species of toxic *Pfiesteria* has recently been confirmed by researchers at North Carolina State's Aquatic Botany Laboratory. The new organism *Pfiesteria shumwayae*, was first detected during a 1995 fish kill in North Carolina's New River Estuary. The new species is genetically and structurally different from *Pfiesteria piscicida*, however it is similar in that its toxicity is triggered by live fish.

including narcosis (a drugged effect), severe headaches, flu-like symptoms, acute loss of short-term memory, respiratory problems, and impaired liver and kidney function. Watermen, citizens, and lab researchers working with high concentrations of the organism in its toxic form, have all reported symptoms. *Pfiesteria* has been positively linked to neurological and physical maladies in researchers who were exposed to the organism's toxins in the lab. The symptoms, however, are reversible over time if the person avoids further contact with the infected water.

Pfiesteria and the Mid-Atlantic Region

Pfiesteria has been found in the waters of the Mid-Atlantic region both in toxic and nontoxic forms. One of the earliest detections of the organism dates back to 1987 when a fish kill on the Indian River in Delaware's Inland Bays went undiagnosed for many years. Water samples that had been collected and preserved from the site of the kill were later tested after *Pfiesteria* had been discovered. Biologists eventually determined that the Delaware samples had toxic levels of the organism present during the 1987 fish kill. However, there was no way to determine if *Pfiesteria* was actually the cause of the fish kill.

Pfiesteria's first positive identification was made by researchers in a lab at North Carolina State University in 1988. In 1991 it was linked to major fish kills in three North Carolina estuaries. In 1995, 25 million gallons of liquid swine manure flowed into the Neuse River after a lagoon was breached. The Neuse River empties into the Pamlico Sound near the city of New Bern. The spill was implicated in producing a toxic outbreak of *Pfiesteria* that killed an estimated 14 million fish. North Carolina health officials temporarily closed parts of the Neuse River and put 364,000 acres of shellfish beds off limits. The most severe toxic attacks have occurred in tributaries of North Carolina's Pamlico Sound where as many as one billion Atlantic menhaden were estimated to be killed in a single incident.

Some suggest that North Carolina's *Pfiesteria* problem has its roots in a booming economy. Tourists and residents are flocking to the coastal areas. Forests and marshlands, which filter pollutants and act as buffer zones, are being rapidly replaced by highways, golf courses, subdivisions, and strip malls. Along with growth has come an increase of pollutants rich in nutrients, flowing into creeks and rivers that feed the Albemerle-Pamlico Sound. In addition, North Carolina has grown to become the second largest hog producing state in the nation. Hundreds of millions of gallons of untreated, nutrient-rich hog feces and urine produced at these factory farms are stored in earthen lagoons that sometimes

leak or collapse. *Pfiesteria* flourish in the presence of phosphate, which is naturally concentrated in the North Carolina coastal region.

In Maryland, two fish kills in the Pocomoke River in August 1997 signaled the start of an ecological crisis in the state. In the first kill, more than 10,000 fish turned up dead; three weeks later thousands of distressed menhaden floated to the water's surface. The state began an intense water quality monitoring program, with orders to close any waterway where more than 20% of the fish had lesions. By September of 1997, parts of the Pocomoke, the Chicamacomico, and Kings Creek, a tributary of the Manokin River, were all declared off-limits to protect Marylanders from the potential harmful human health impacts associated with exposure to *Pfiesteria* toxins. Other reports from Maryland noted that in 1996 an estimated 20,000 striped bass in a Maryland fish farm on the Chesapeake Bay were killed. While laboratory analysis determined *Pfiesteria* was present, other potentially toxic organisms were also present. Thus, it was impossible to attribute the cause of the mortalities to *Pfiesteria.*

Virginia has been spared a major toxic *Pfiesteria* outbreak, but in 1997 officials were seeing lesion rates as high as 75% in fish, primarily menhaden, in the Rappahannock River. No fish kills were reported and no closures were imposed. It is important to note that while lesions on fish are a sign of *Pfiesteria*, lesions and sores also affect fish for other reasons that are not related to the toxic organism.

The Mid-Atlantic seafood industry has also been affected by the outbreak of *Pfiesteria*, with seafood sales reported to be off as much as 60% in some areas. Seafood industry leaders had felt that negative media reports had scared consumers away from commercial seafood products that were marketed as safe and wholesome. The industry began an aggressive campaign to inform consumers that seafood was safe to eat. They also noted that most of the affected fish were menhaden, which are not marketed as human food, but rather as baitfish and fertilizer products.

METHODS

A mail survey effort was determined to be the most effective method of obtaining the needed information from regional residents. In addition to the mail questionnaire, appropriate cover letters explaining the intent of the survey and a postcard reminder were designed for this project (see Appendix A). Six states within the Mid-Atlantic region were originally targeted as sampling states (North Carolina, Virginia, Maryland, Delaware, New Jersey, and New York). At the time the survey instrument was first mailed (November 1998), the four states from North Carolina to Delaware had experienced toxic *Pfiesteria* outbreaks or had nontoxic forms of the organism identified in water samples taken from state tidal waters. The states of New York and New Jersey had not experienced any *Pfiesteria*-related problems,[3] but a smaller subset of residents was sampled to determine if their responses could reveal any major differences between states with *Pfiesteria* problems and those without any reported incidents. After analyzing the data, it was determined that the findings from these two states' residents were not vital to the overall understanding of the impacts of *Pfiesteria* on regional residents, and only data collected from respondents in the four states of North Carolina, Virginia, Maryland, and Delaware is presented in this report.

Residents of the four states were sampled using a two-part stratification. A statewide sample (N=600) and a coastal sample (N=200) were selected for each of these states. The coastal sample was selected by identifying counties within the four states that were coastal or tidal in nature. See Appendix B for a listing of the coastal counties selected in each state. The primary reason this stratification was employed was to insure an adequate number of respondents living in coastal areas would be sampled. This was important in determining whether there was greater interest and knowledge about *Pfiesteria* from residents in coastal areas where the organism is found.

The initial mailings were sent during the fall of 1998. Approximately 3,172 surveys (including cover letters and postage-paid return mail envelopes) were distributed to residents in the four states. If responses were not received from the targeted sample within seven to 10 days, a follow-up postcard reminder was mailed. Approximately two weeks after the initial mailing, a follow-up survey

[3] New Jersey officials recently reported that *Pfiesteria* had been linked to a fish kill in the Tuckahoe River at Corbin City, NJ in September 1999. Upon further investigation scientists found the organism in the water column and in bottom sediments. According to Department of Environmental Protection officials, it is the only place *Pfiesteria* has been found in coastal New Jersey.

instrument, along with a revised cover letter and postage-paid return envelope, was re-sent to those residents who had still not returned a completed questionnaire.

Due to a higher than expected rate of undeliverable surveys (for reasons that included incomplete or wrong addresses, forwarding notice expired, etc.) for the coastal samples in Delaware (41 percent undeliverable) and Maryland (29 percent undeliverable), an additional 100 names were randomly selected from each state to receive the initial questionnaire and cover letter. This mailing, and the subsequent follow-ups, began in January 1999 and proved to be successful at gaining additional responses from these targeted coastal residents.

Of the 3,372 residents who were mailed a copy of the survey instrument, 561 mailings were returned undeliverable by the U.S. Postal Service due to incorrect addresses or other reasons, thus leaving an effective sample size of 2,811. Seven hundred forty-nine completed questionnaires were received for an overall response rate of 27%. Response rates varied little by state, except for Delaware responses which were significantly higher than the other states. This abnormality may be explained by the fact that the University of Delaware Sea Grant Program initiated the survey effort with the university's name and logo present on all mailing materials. See Table 1 for a complete response rate by state.

Table 1. Mail Questionnaire Response by State

	DE (N=242)		MD (N=189)		VA (N=160)		NC (N=158)	
	ST	CST	ST	CST	ST	CST	ST	CST
Original Sample Size	600	199 100*	600	200 100*	574	200	600	199
Nondeliverables	107	82 8*	67	58 11*	66	34	88	40
Effective Sample Size	493	117 92*	533	142 89*	508	166	512	159
# Returned	159	39 44*	131	38 20*	116	44	106	52
% Response After Nondeliverables	32%	33% 48%*	25%	27% 22%*	23%	24%	21%	33%
Total Percent Response	34%		25%		24%		24%	

ST represents random samples selected from the statewide population in each state.
CST represents random samples selected from coastal counties within each state.
*Represents supplemental mailings to DE and MD coastal samples due to high number of nondeliverables.

STUDY RESULTS

To provide a complete analysis of these study findings, the results are presented in three distinct forms. Initially, overall responses from the entire set of responding residents are presented to depict a regional profile of the study subjects. As this information is limited in its use for state and local decision makers, results by state of resident are also presented. This allows for a more complete understanding of how residents within the various states feel about concerns related to *Pfiesteria*. Finally, results are presented based on geographic location within a particular state (i.e., coastal versus inland comparisons). This analysis more fully describes differences between those living near the water, who may have more of an interest in the issue, and those living away from the coastal environment, who may not be as knowledgeable or interested. Statistical tests have been performed and significant differences are noted among state residents and between coastal and inland residents where they occurred.

Socioeconomic Characteristics

State Comparisons. Overall, 44% of respondents were college graduates, with little difference observed among the states (between 42% and 45%). The age distribution of respondents was well-dispersed. Twenty percent were under 40 years of age, 44% were between the ages of 40 and 59 years, and 37% were 60 years of age or greater. Among the states significant differences were obvious. Delawareans tended to be older than residents from the other states, with 42% being 60 years of age or older, while only about one-third of Maryland (35%), Virginia (34%), and North Carolina (34%) residents were 60 years old or greater. Almost one-half of all respondents reported incomes of greater than $50,000. Delaware (52%) and Maryland (53%) residents reported incomes in this range more often than Virginia (43%) or North Carolina (44%) residents; however, these differences were not statistically significant (Table 2).

Males were twice as likely to respond to the survey than females, with 66% of the respondents being males. No differences were observed among the states (between 66% and 69%). Overall, one-third of the residents were retired, with no differences observed among the states. Thirteen percent of all respondents noted that they belonged to an environmental group, with no differences observed (between 12% and 15%). When respondents were asked if they, or anyone in their immediate household, were employed in a job related to the marine waters of the Mid-Atlantic, only 6% overall responded

affirmatively (Table 2). Examples of job types were provided for reference; they included occupations such as commercial fisherman, seafood buyer/seller, charterboat captain, and marina operator. No differences were observed among respondents from the various states.

Coastal/Inland Comparisons. A similar pattern emerged between coastal (41%) and inland (47%) residents with regard to being a college graduate. Age distribution was significantly different between the regions as more coastal residents (43%) were 60 years of age or older than were inland residents (33%). Income was also a statistically significant variable between the regions, with inland residents (53%) more likely to report incomes of greater than $50,000 than were coastal residents (42%). Significantly more males living in coastal regions (72%) responded to the survey than inland region males (64%), and significantly more retirees resided in coastal areas (42%) than in inland areas (27%). Environmental group membership revealed no significant difference between the two groups (15% coastal residents versus 13% inland residents). As expected, more coastal residents (10%) than inland residents (3%) indicated that they, or family members, had marine-related jobs, and the differences were significant (Table 2). See Appendices C and D for other profile information on state residents.

Table 2. Descriptive Profile of Mail Survey Respondents, by State and Region (Values are Percentages)*

	All	State				Region	
		DE	MD	VA	NC	Coastal	Inland
EDUCATION	(N=722)	(N=234)	(N=182)	(N=155)	(N=150)	(N=281)	(N=425)
Grade School	2	2	3	2	2	3	2
Some High School	4	6	4	4	2	6	3
High School Graduate	21	26	17	21	23	24	21
Some College	27	22	31	28	31	27	27
College Graduate	25	22	25	25	29	23	26
Post Graduate	19	23	19	20	13	18	21
AGE[1,2]	(N=712)	(N=231)	(N=178)	(N=151)	(N=151)	(N=274)	(N=422)
Under 20	1	1	--	2	--	--	1
20 - 29	6	5	5	11	5	5	6
30 - 39	13	8	15	13	17	11	14
40 - 49	22	19	24	22	27	19	24
50 - 59	22	26	21	20	18	22	22
60 - 69	19	19	15	21	19	21	17
70 & Greater	18	23	20	13	15	22	16
INCOME[3]	(N=628)	(N=204)	(N=154)	(N=140)	(N=129)	(N=242)	(N=374)
Less than $10,000	3	2	4	5	2	2	4
$10,000 - $19,999	9	9	10	12	5	12	7
$20,000 - $29,999	11	10	6	11	16	14	9
$30,000 - $39,999	14	12	16	13	13	16	12
$40,000 - $49,999	15	15	11	16	21	15	16
$50,000 - $74,999	22	23	25	18	22	24	21
$75,000 - $99,999	13	14	18	11	8	11	15
$100,000 & Greater	14	15	10	14	14	7	17
Other							
Gender (% Male)[3]	67	69	67	67	66	72	64
Employment (Retired)	33	39	31	30	30	42	27
Environmental Group	13	12	15	12	15	15	13
Employment (Marine)[3]	6	5	6	5	7	10	3

*Totals may not equal 100% due to rounding.
[1]Significant differences observed among state residents at .01 level of significance.
[2]Significant differences observed between regional residents at .05 level of significance.
[3]Significant differences observed between regional residents at .01 level of significance.

Beach Visitation and Activities

State Comparisons. Overall, 89% of study respondents visited beaches in the Mid-Atlantic region. Significant differences were noted among state residents and between regional residents. As expected, most respondents tended to visit beaches within their state of residence or a neighboring state. For example, 97% of Delawareans visited beaches within their state, and 61% visited beaches in the adjoining state of Maryland. Maryland residents have a similar visitation pattern, with 94% visiting Maryland beaches and 55% visiting beaches in Delaware.

Visitors to coastal areas participated in many different activities, ranging from swimming and enjoying the beaches to visiting nature areas along the coast. Overall, swimming and other beach-related activities (78%) and eating at seafood restaurants (78%) were the two most popular activities of coastal visitors. Preferences for swimming and beach activities were similar by state respondents (between 76% and 81%); however, differences were observed for eating at seafood restaurants, where North Carolina residents (87%) dedicated more of their time to this activity than residents of the other states (between 72% and 81%). Forty-nine percent of all respondents visited nature areas, again with North Carolina residents (59%) indicating a higher preference for this activity than other state residents (between 44% and 52%). Forty-two percent of all residents indicated that they bought local seafood, with little variation among the states. Crabbing (26%) and clamming (10%) were engaged in more often by Delaware residents than by respondents from other states (Table 3). These findings could have implications for visitors who may change their beach visitation and activity patterns based on a *Pfiesteria* outbreak. This issue is explored in greater detail later in the report.

Coastal/Inland Comparisons. Coastal residents (92%) reported a slightly greater incidence of visiting Mid-Atlantic beaches than inland residents (87%), but the difference was not significant. In nearly every case, except for the North Carolina coast, coastal residents reported visiting a specific Mid-Atlantic state's beaches more often than inland residents. This could be due to the fact that many inland residents throughout the region have more knowledge about, and a greater preference for, North Carolina beaches than for other state coastal areas. Few differences are noted between coastal and inland residents with regard to activity participation. Activities such as boating and sailing (35% versus 25%), crabbing (20% versus 15%), and clamming (11% versus 1%) all reflect a greater level of participation by coastal residents than by inland residents (Table 3).

Table 3. Percent of Residents Visiting Mid-Atlantic Beaches and Their Activities, by State and Region							
	All	State				Region	
		DE	MD	VA	NC	Coastal	Inland
	(N=738)	(N=240)	(N=186)	(N=156)	(N=155)	(N=289)	(N=432)
Have visited Mid-Atlantic beaches in past 5 years[1]	89	93	86	86	90	92	87
Coastal Area Visited	(N=646)	(N=218)	(N=157)	(N=132)	(N=138)	(N=262)	(N=369)
New York Coast	6	6	6	5	5	6	6
New Jersey Coast	22	34	26	12	9	22	23
Delaware Coast[2]	50	97	55	14	6	60	43
Maryland Coast[2]	51	61	94	26	12	57	47
Virginia Coast[2]	42	28	40	83	26	48	37
North Carolina Coast	52	26	36	62	100	47	55
Activities	(N=657)	(N=223)	(N=159)	(N=134)	(N=140)	(N=265)	(N=377)
Swimming/Beach Activities	78	76	79	81	76	74	80
Eating at Seafood Restaurants[3]	78	74	81	72	87	76	80
Visiting Nature Areas[1]	49	44	52	45	59	50	49
Buying Local Seafood	41	42	42	38	43	43	40
Fishing	40	41	33	43	44	44	39
Boating/Sailing[2]	29	35	26	28	26	35	25
Crabbing[3]	17	26	18	10	10	20	15
Clamming[2,3]	6	10	6	2	1	11	1
Other	13	11	13	14	15	10	15

[1]Significant differences observed among state residents at .05 level of significance.
[2]Significant differences observed between regional residents at .01 level of significance.
[3]Significant differences observed among state residents at .01 level of significance.

Rating the Importance of Coastal Problems

State Comparisons. Respondents were provided with a list of 10 problems that could affect coastal areas across the country to varying degrees. Survey recipients were instructed to rate the problems on a 5-point scale (1 = Least Serious and 5 = Most Serious). This question and rating scheme were designed to understand how residents perceive the seriousness of the issues, as well as putting into

context how *Pfiesteria* rates along with other potential problems. Overall, seven of the 10 problems were rated as fairly serious, with mean ratings between 4.3 (water pollution) and 3.8 (*Pfiesteria*, shoreline erosion, and coastal population growth). The three lowest rated problems (red or brown tides, dredging, and rising sea level) received neutral ratings, with mean ratings between 3.4 and 2.9. Significant differences were observed for three of the issues among state residents. Delaware (4.1) and Maryland (4.1) residents rated chemical and oil spills higher than Virginia (3.9) and North Carolina (3.9) residents. Also, shoreline erosion received higher mean ratings from Delaware (3.8), Maryland (3.8), and North Carolina (3.7) residents than from Virginia residents (3.5). Finally, Delaware residents (3.6) rated red and brown tides as more serious concerns than did North Carolina (3.4), Maryland (3.3), or Virginia (3.2) residents (Table 4).

Coastal/Inland Comparison. Coastal and inland residents' mean ratings were fairly consistent except for the issues of population growth in coastal areas (3.8 for coastal residents versus 3.7 for inland residents) and rising sea level (2.9 for coastal residents versus 3.0 for inland residents) where statistical differences were observed (Table 4). See Appendix E for a listing of other coastal problems mentioned by state residents.

Table 4. Residents' Ratings of Problems Affecting Coastal Areas, by State and Region (Mean Rating Values Based on 5-point scale; 1 = Least Serious and 5 = Most Serious)

Coastal Problem	All (N=691)	State				Region	
		DE (N=226)	MD (N=177)	VA (N=146)	NC (N=141)	Coastal (N=276)	Inland (N=402)
Water Pollution	4.3	4.3	4.4	4.2	4.4	4.4	4.3
Chemical and Oil Spills[1]	4.0	4.1	4.1	3.9	3.9	4.1	4.0
Loss of Wetlands	3.9	3.9	4.0	3.8	4.0	3.9	4.0
Declining Fisheries Resources	3.9	3.8	4.0	3.7	4.1	3.9	3.9
Pfiesteria	3.8	3.9	3.9	3.5	3.9	3.8	3.9
Population Growth in Coastal Areas[2]	3.8	4.0	3.7	3.6	3.7	3.8	3.7
Shoreline Erosion[1]	3.7	3.8	3.8	3.5	3.7	3.8	3.7
Red or Brown Tides[1]	3.4	3.6	3.3	3.2	3.4	3.3	3.4
Dredging	3.0	3.0	3.2	2.9	2.9	3.0	3.0
Rising Sea Level[3]	2.9	3.1	2.8	2.9	2.7	2.9	3.0

[1]Significant differences observed among state residents at .05 level of significance.
[2]Significant differences observed between regional residents at .05 level of significance.
[3]Significant differences observed between regional residents at .01 level of significance.

The Public's Understanding of *Pfiesteria*

State Comparisons. Overall, 93% of the study sample reported that they had heard of *Pfiesteria*. Significant differences were noted, with 99% of Delawareans and 97% of Marylanders indicating they had heard of it, compared to 82% of Virginians and 88% of North Carolinians. When those who had heard of it were asked to describe what they thought it was, there were a variety of responses offered. Respondents were provided five selections, summarized in Table 5. They were instructed to select only one response. Four responses were almost equally divided among all of the respondents: a form of pollution (23%), a disease in fish (22%), a parasite in fish (22%), and a toxin or poison (21%). The response, "a predator that attacks fish", was selected by only 5% of the study subjects, and 6% suggested it was "other things" (Table 5). For a listing of other responses by state residents see Appendix F.

Significant differences begin to emerge among state residents with regard to this question. For instance, Delawareans (31%) had a greater impression that *Pfiesteria* was a form of pollution than residents of the other states (between 14% and 23%). Virginians (30%) were more likely to indicate that they thought it was a disease in fish than the other state residents (between 14% and 25%) (Table 5).

Coastal/Inland Comparisons. Responses from coastal and inland residents about *Pfiesteria* perceptions revealed major differences. Inland residents were more inclined to think of *Pfiesteria* as a disease in fish (26% versus 16%), whereas coastal residents thought of it more often as a form of pollution (28% versus 19%) or as a predator that attacks fish (8% versus 3%) (Table 5).

Table 5. Percent of Residents Who Have Heard of *Pfiesteria* and Their Perceptions, by State and Region*

	All	State				Region	
		DE	MD	VA	NC	Coastal	Inland
Heard of *Pfiesteria*[1,2]	**(N=723)**	**(N=237)**	**(N=186)**	**(N=153)**	**(N=147)**	**(N=285)**	**(N=423)**
	93	99	97	82	88	97	90
Perceptions of *Pfiesteria*	**(N=670)**	**(N=232)**	**(N=176)**	**(N=127)**	**(N=134)**	**(N=274)**	**(N=383)**
Form of Pollution[1,2]	23	31	18	14	23	28	19
Disease in Fish[2,3]	22	21	25	30	14	16	26
Parasite in Fish	22	20	22	28	17	18	24
Toxin or Poison	21	17	23	20	29	20	22
Predator that Attacks Fish[2]	6	6	4	3	10	8	3
Other	7	6	8	6	7	9	5

*Totals may not equal 100% due to rounding
[1]Significant differences observed among state residents at .01 level of significance.
[2]Significant differences observed between regional residents at .01 level of significance.
[3]Significant differences observed among state residents at .05 level of significance.

Harmful Nature of *Pfiesteria*

State Comparisons. Limited scientific information suggests that *Pfiesteria* can be harmful to humans. Some of the human health effects understood by the scientific community have been discussed earlier. Overall, 95% of the study sample indicated that they thought the organism could be harmful to humans. There was a significant difference noted among the states with North Carolina residents (99%) feeling most strongly about this issue. When asked to indicate how they thought it could be harmful, and being allowed to select all the responses that might apply, two-thirds (66%) reported that it harms the environment which can indirectly harm people, 64% were concerned that it could harm people through eating seafood, 54% thought that swimmers or those wading in the water could be harmed, and 47% indicated that they thought fishermen in boats could be harmed if they touched fish or water during a toxic outbreak. Very few people (3%) believed that the organism could emit aerosols into the air and harm people (Table 6).

Statistical differences among the states were apparent for some of the statements regarding *Pfiesteria* being harmful to people. Delawareans (70%) felt more strongly than other state residents (between 57% and 67%) that people can be harmed by eating seafood from *Pfiesteria*-infested waters. Virginians were least likely to believe that *Pfiesteria* could harm people swimming or wading in the water (39%) or fishermen who touched fish or the water where an outbreak had occurred (36%). Maryland residents (56%) had the strongest conviction that fishermen could be harmed by touching fish or the water during an outbreak. North Carolina residents (60%) were more inclined to suggest *Pfiesteria* can harm swimmers or waders than any of the other state residents (between 39% and 58%) (Table 6).

Coastal/Inland Comparisons. Inland residents (97%) voiced a slightly higher concern than coastal residents (93%) that *Pfiesteria* could be harmful to people, although the differences were not statistically significant. Inland residents were more inclined to think people could be harmed by eating seafood (69% versus 58%). Coastal residents were more inclined to feel swimmers or waders in the water could be harmed (59% versus 51%) and that fishermen could be harmed if they touched fish or water where an outbreak had occurred (51% versus 44%) (Table 6). See Appendix G for other responses from state residents.

Table 6. Percent of Residents Who Think *Pfiesteria* is Harmful to People and How It Can Harm People, by State and Region

	All	State				Region	
		DE	MD	VA	NC	Coastal	Inland
***Pfiesteria* Harmful to People**	(N=654)	(N=229)	(N=173)	(N=119)	(N=132)	(N=269)	(N=373)
Percent who think *Pfiesteria* is harmful to people[1]	95	95	94	91	99	93	97
How *Pfiesteria* Harms People	(N=640)	(N=220)	(N=168)	(N=117)	(N=134)	(N=258)	(N=370)
Harms the environment, which indirectly harms people	66	64	70	62	68	66	67
Harms people if they eat seafood[2]	64	70	62	67	57	58	69
Harms swimmers or waders in the water[3,4]	54	56	58	39	60	59	51
Harms fishermen in boats if they touch fish or water[3,4]	47	46	56	36	46	51	44
It's in the air, can harm people if they are in the area	3	4	3	2	5	5	3
Other[4]	4	3	4	3	7	6	3

[1]Significant differences observed among state residents at .05 level of significance.
[2]Significant differences observed between regional residents at .01 level of significance.
[3]Significant differences observed among state residents at .01 level of significance.
[4]Significant differences observed between regional residents at .05 level of significance.

Conditions Contributing to *Pfiesteria*

State Comparisons. Survey recipients were asked to rank the conditions that they felt contributed to *Pfiesteria* blooms in their state by selecting their top three choices from a listing of possible conditions. Individuals were then requested to rank their three most important conditions. Table 7 reflects the collective responses (total of top three selections) for each state respondent. There were significant differences among state residents regarding livestock farming practices. Virginia residents (22%) were less inclined to think that this practice caused blooms to occur than residents of the other three states (between 24% and 25%). North Carolina residents (24%) felt that stormwater drainage and sewage plant discharges were more responsible for outbreaks than residents from other states (between 16% and 20%). Delaware (22%) and Maryland (21%) residents were more likely to suggest that runoff

from crops caused *Pfiesteria* outbreaks than were residents of Virginia (15%) or North Carolina (11%) (Table 7).

Coastal/Inland Comparisons. Many of the responses between coastal and inland residents were identical; however, two notable conditions revealed significant differences. Inland residents (25%) were more inclined to indicate they thought livestock farming caused toxic *Pfiesteria* blooms than coastal residents (23%). The lowest rated concern, that *Pfiesteria* occurs naturally and is not caused by human activity was supported by more coastal residents (7%) than by inland residents (3%) (Table 7). See Appendix H for other responses suggested by state residents.

Table 7. Percent of Residents Believing Certain Conditions Contribute to *Pfiesteria* Blooms, by State and Region[a*]

Conditions Contributing to *Pfiesteria* Blooms	All (N=628)	State				Region	
		DE (N=218)	MD (N=167)	VA (N=114)	NC (N=128)	Coastal (N=259)	Inland (N=359)
Livestock farming practices[1,2]	24	25+	25+	22	24+	23+	25+
Pollution from factories and industry	20	17	18	24+	22	19	20
Stormwater drainage/sewage plant discharges from cities and towns[3]	19	18	16	20	24	20	19
Runoff from crop farming[1]	18	22	21	15	11	18	19
Over-fertilizing lawns or failing septic systems from residential homes	14	14	13	14	13	13	14
Pfiesteria occurs naturally and is not caused by human activity[4]	5	4	6	5	5	7	3

[a]Percentages based on collective responses of three most important conditions mentioned by residents.
*Totals may not equal 100% due to rounding.
+ Indicates most important condition mentioned by state and regional residents.
[1]Significant differences observed among state residents at .01 level of significance.
[2]Significant differences observed between regional residents at .05 level of significance.
[3]Significant differences observed among state residents at .05 level of significance.
[4]Significant differences observed between regional residents at .01 level of significance.

Concerns about *Pfiesteria*

State Comparisons. The study participants were asked to identify what concerned them the most about *Pfiesteria*. They were provided with six responses and were asked to select their three most important concerns. They could also contribute their own responses. Table 8 shows a breakdown by state for their collective responses (total of top three selections). Asterisks denote the concern most often reported by state residents. Overall, the respondents were most concerned about the health of marine animals (23%). The responses among state residents were similar, with Maryland (23%) and Virginia (25%) residents mentioning harm to marine animals as their most important concern. The next highest rated concern was that *Pfiesteria* indicates too much pollution is going into waterways. Overall, 22% of the sample mentioned this as an important concern. Delaware and North Carolina residents rated it as their top concern. Significant differences were noted for the concern about personal health, where Delaware (20%), Maryland (19%), and North Carolina (19%) residents voiced greater concern than Virginia (17%) residents. Economic concerns were more important to Maryland (20%) and Virginia (17%) residents, with Delaware residents (15%) being more concerned about seafood safety than the residents of the other states (between 12% and 13%) (Table 8).

Coastal/Inland Comparisons. Concerns voiced by coastal and inland residents were nearly identical except for the concern about economic losses to people making a living on the water. Coastal residents (19%) rated this as a higher concern than inland residents (14%) (Table 8). See Appendix I for other concerns mentioned by state residents.

Table 8. Percent of Residents Indicating Their Concerns about *Pfiesteria*, by State and Region[a*]							
Concerns about *Pfiesteria*	All (N=675)	State				Region	
		DE (N=235)	MD (N=178)	VA (N=127)	NC (N=134)	Coastal (N=278)	Inland (N=384)
Marine animals can be affected and die	23	23	23[+]	25[+]	24	22	24[+]
Indicates too much pollution is going into waterways	22	22[+]	23	22	24[+]	22[+]	23
Can affect my health if I come in contact with it[1]	19	20	19	17	19	19	19
Can be economic losses to people making living on water[2,3]	16	14	20	17	15	19	14
Can affect the seafood I like to eat[1]	13	15	12	13	12	12	14
Can affect my water-based recreation activities[2]	6	7	4	4	6	6	6

[a]Percentages based on collective responses of three most important concerns mentioned by residents .
*Totals may not equal 100% due to rounding.
[+]Indicates most important concern mentioned by state and regional residents.
[1]Significant differences observed among state residents at .05 level of significance.
[2]Significant differences observed among state residents at .01 level of significance.
[3]Significant differences observed between regional residents at .01 level of significance.

Statements about *Pfiesteria*

State Comparisons. Survey respondents were provided with a series of eight statements about *Pfiesteria* and asked to agree or disagree with the statements. The statements were diverse in nature and ranged from what might cause *Pfiesteria* outbreaks, to whether respondents had the information they needed to make decisions about *Pfiesteria*. A 5-point scale was used with 1 = Strongly Disagree and 5 = Strongly Agree. Mean scores are reported, along with the percentage of respondents who "agreed" or "strongly agreed" with the statement.

The highest rated statement overall, with 85% of residents either "agreeing" or "strongly agreeing," was that money being spent by their state government to understand and help correct problems caused by *Pfiesteria* is a good investment for their state's future. The statement received a mean rating score of 4.1 on the 5-point scale. The next highest rated statement, with 64% "agreeing/strongly agreeing," was that agricultural runoff can cause *Pfiesteria* outbreaks (3.7 mean rating). There was a significant difference observed among state residents, with Delawareans (3.9 mean rating) showing stronger support for this statement than the other state residents (between 3.6 and 3.7

mean rating). Another statement that revealed statistical differences among state residents was that the news media does a good job of informing people about *Pfiesteria* without creating to much fear; Delaware and Maryland residents (3.5 mean ratings) gave this statement higher rating values than did Virginia and North Carolina residents (3.3 mean ratings). Also, Virginia and North Carolina residents (3.3 mean ratings) felt more strongly that residential and commercial development causes *Pfiesteria* outbreaks than Maryland (3.1 mean rating) or Delaware (3.2 mean rating) residents (Table 9).

Overall, only about one-third (32%) of the respondents "agreed/strongly agreed" that they had enough knowledge about *Pfiesteria* to make informed decisions that may affect them (2.8 mean rating). This suggests that there is still a role that can be played by communicators, information specialists, and the media to disseminate factual, objective information to targeted audiences. Forty-one percent overall "agreed/strongly agreed" that if public health and environmental officials said it was safe to return to the water where a *Pfiesteria* outbreak had occurred, they would trust their judgement (3.1 mean rating).

Twenty-eight percent "agreed/strongly agreed" with the statement that science, not politics, forms the basis for decisions that are made in their state about *Pfiesteria* (2.9 mean rating). This response suggests that there is some concern being voiced by residents that political influences may override scientific evidence in some decisions that are made about *Pfiesteria.* Only 10% of respondents "agreed/strongly agreed" that *Pfiesteria* occurs naturally in the marine environment with humans having little or no control over the outbreaks (2.1 mean rating). This low rating may indicate that respondents feel there are steps that can be taken by resource managers, public health officials, the general public, or others to minimize the negative impacts caused by *Pfiesteria* outbreaks or even prevent outbreaks in the future (Table 9).

Coastal/Inland Comparisons. Many of the responses from coastal and inland residents to the statements about *Pfiesteria* were similar (Table 9). The only statements that revealed significant differences were, "Agricultural runoff can cause *Pfiesteria* outbreaks in coastal waters," where inland residents (3.8 mean rating) felt more strongly about this than coastal residents (3.7 mean rating); "I feel I have enough knowledge about *Pfiesteria* to make informed decisions that affect me" (3.0 for coastal residents versus 2.7 for inland residents); and "*Pfiesteria* occurs naturally in the marine environment and humans have little or no control over preventing outbreaks" (2.3 for coastal residents versus 2.0 for inland residents).

Table 9. Residents' Rating of Statements about *Pfiesteria*, by State and Region

Pfiesteria Statements	All (N=672)		State								Region			
			DE (N=231)		MD (N=181)		VA (N=126)		NC (N=134)		Coastal (N=278)		Inland (N=383)	
	V	%	V	%	V	%	V	%	V	%	V	%	V	%
Money being spent by my state government to understand and help correct any problems caused by *Pfiesteria* is a good investment for my state's future.	4.1	85	4.1	85	4.1	87	4.1	84	4.2	84	4.1	85	4.1	86
Agricultural runoff can cause *Pfiesteria* outbreaks in coastal waters.[1,2]	3.7	64	3.9	71	3.7	67	3.6	56	3.6	57	3.7	62	3.8	66
Newspapers, magazines, and TV have done a good job of informing me about *Pfiesteria* without creating too much fear.[3]	3.4	59	3.5	65	3.3	59	3.5	52	3.3	55	3.4	62	3.3	56
Residential/commercial development can cause *Pfiesteria* outbreaks in coastal waters.[1]	3.2	37	3.2	38	3.1	34	3.3	36	3.3	43	3.2	36	3.3	38
If public health and environmental officials say it is safe to swim, boat, or fish where a *Pfiesteria* outbreak had previously occurred, I would trust their judgement.	3.1	41	3.2	44	3.0	40	3.0	39	3.0	40	3.1	43	3.1	39
Science, not politics, forms the basis for decisions that are made in my state about *Pfiesteria*.	2.9	28	3.0	33	2.8	26	2.9	28	2.7	25	2.9	28	2.9	28
I feel I have enough knowledge about *Pfiesteria* to make informed decisions that affect me.[4]	2.8	32	2.9	34	3.0	39	2.7	23	2.8	30	3.0	36	2.7	30
Pfiesteria occurs naturally in the marine environment and humans have little or no control over preventing outbreaks.[4]	2.1	10	2.1	9	2.1	9	2.3	9	2.2	13	2.3	14	2.0	7

V represents average rating value based on 5-point scale; 1 = Strongly Disagree and 5 = Strongly Agree.

% represents percent of respondents who "Agree" or "Strongly Agree" with statement.

[1]Significant differences observed between state residents at .01 level of significance.

[2]Significant differences observed between regional residents at .05 level of significance.

[3]Significant differences observed between state residents at .05 level of significance.

[4]Significant differences observed between regional residents at .01 level of significance.

***Pfiesteria* Awareness**

State Comparisons. The study respondents were asked if they were aware of *Pfiesteria* outbreaks in their respective states. The two states which have had the greatest number of outbreaks and major fish kills, Maryland (95%) and North Carolina (89%), generated the greatest level of awareness from respondents. Residents in the states of Delaware (60%) and Virginia (71%) indicated significantly lower levels of awareness (Table 10). These two states also had the highest number of respondents reporting that they were unsure whether outbreaks had occurred (25% and 22% respectively).

As a follow-up, survey recipients who indicated they were aware of outbreaks were asked if they thought their state government officials responded adequately during toxic outbreaks. Overall, about one-third (35%) of all respondents felt officials responded adequately. Maryland residents (45%) voiced the greatest level of support, followed by Virginia residents (33%). Between one-third and one-half of respondents from these states indicated they were unsure if officials responded in an adequate fashion (36% and 54%, respectively). Only about one-third of Delaware (31%) and Virginia (33%) residents felt officials reacted positively, with 54% of Virginians and 44% of Delawareans indicating they were unsure how their state officials had responded (Table 10).

Coastal/Inland Comparisons. Inland residents (78%) were slightly more aware of *Pfiesteria* outbreaks in their states than coastal residents (74%), although this difference was not significant (Table 10). Coastal residents (36%) were more inclined to indicate that their state government officials responded adequately to the outbreaks than inland residents (33%). Inland residents (46%) reported a greater degree of uncertainty about whether government officials responded adequately than did coastal residents (37%). See Appendix J for additional comments from state residents.

Table 10. Percent of Residents Aware of *Pfiesteria* Outbreaks and State Government Response, by State and Region[a*]

	All			State												Region					
				DE			MD			VA			NC				Coastal			Inland		
***Pfiesteria* Awareness**	(N=674)			(N=234)			(N=180)			(N=126)			(N=133)			(N=275)			(N=387)		
Aware of *Pfiesteria* Outbreak in State[1]	Y	N	U	Y	N	U	Y	N	U	Y	N	U	Y	N	U	Y	N	U	Y	N	U
	77	7	16	60	15	25	95	2	3	71	7	22	89	1	11	74	10	16	78	5	16
Government Response	(N=512)			(N=140)			(N=169)			(N=86)			(N=117)			(N=204)			(N=299)		
State government officials responded adequately to *Pfiesteria* outbreaks[1,2]	Y	N	U	Y	N	U	Y	N	U	Y	N	U	Y	N	U	Y	N	U	Y	N	U
	35	23	42	31	25	44	45	19	36	33	14	54	26	35	39	36	27	37	33	21	46

[a] Y=Yes; N=No; U=Unsure

*Totals may not equal 100% due to rounding.

[1]Significant differences observed among state residents at .01 level of significance.

[2]Significant differences observed between regional residents at .05 level of significance.

Contact with Officials

State Comparisons. In order to gauge how active citizens are about communicating with state officials regarding *Pfiesteria* concerns, residents were specifically asked if they had contacted elected officials or state agency personnel to discuss any concerns related to *Pfiesteria*. Overall, only 3% of residents indicated that they had contacted either of these types of individuals. Although no statistical differences were observed, the responses were greatest for residents of North Carolina (6% had contacted elected officials; 5% had contacted a state agency employee). When individuals were asked if they had ever attended a public meeting or public hearing about *Pfiesteria* issues significant differences were noted. Five percent of residents overall reported attending a meeting, and 13% of North Carolina residents reported doing so, compared with 4% of Delaware and Maryland residents and 2% of Virginia residents. This finding may reflect the greater concern among residents of North Carolina about *Pfiesteria*, the state where outbreaks have been most acute (Table 11).

Coastal/Inland Comparisons. No differences were evident between coastal and inland residents when asked if they had contacted an elected official (4% for coastal residents versus 2% for inland residents), or contacted a state natural resource or public health official (4% for coastal residents versus 3% for inland residents). There were significant differences observed between coastal (9%) and inland (2%) residents with regard to having attended a public meeting or hearing on *Pfiesteria* (Table 11).

Table 11. Percent of Residents Having Contact with State Officials about *Pfiesteria*, by State and Region

	All	State				Region	
		DE	MD	VA	NC	Coastal	Inland
	(N=673)	(N=232)	(N=180)	(N=126)	(N=134)	(N=274)	(N=387)
Contacted elected official	3	3	2	1	6	4	2
	(N=674)	(N=234)	(N=179)	(N=126)	(N=134)	(N=275)	(N=387)
Contacted employee of state natural resource agency or public health agency	3	3	2	2	5	4	3
	(N=672)	(N=235)	(N=178)	(N=125)	(N=133)	(N=274)	(N=386)
Attended a public meeting or public hearing[1,2]	5	4	4	2	13	9	2

[1]Significant differences observed among state residents at .01 level of significance.
[2]Significant differences observed between regional residents at .01 level of significance.

Effects of *Pfiesteria* on Travel

State Comparisons. There has been concern voiced by some individuals about whether *Pfiesteria* outbreaks, especially during the summer travel months, would adversely affect visitors in their travel to coastal tourist destinations. Respondents were asked to answer a question of whether a *Pfiesteria* outbreak would affect their travel plans. Overall, about one-third (32%) of the respondents indicated that they would still visit a coastal area if an outbreak occurred, but would change some of the activities that they had planned if there were an outbreak. This was the only response that showed a significant difference across states, with Delaware residents (38%) more inclined to voice this response than other state residents (between 26% and 31%). Twenty-nine percent of respondents indicated that they would go to another coastal area unaffected by *Pfiesteria*. This response was considerably higher for North Carolina residents (39%) than for other state residents in the region (between 26% and 28%), although significant differences were not noted (Table 12).

Coastal/Inland Comparisons. When asked how *Pfiesteria* would affect travel plans to a coastal area, two significant differences were observed between coastal and inland residents. Inland residents were more inclined to go to another coastal area unaffected by *Pfiesteria* (33% versus 24%), and coastal residents were more apt to keep their original travel plans to visit the coastal areas (16% versus 8%) (Table 12).

Table 12. Percent of Residents Indicating How *Pfiesteria* Would Affect Coastal Travel, by State and Region*

Pfiesteria's Effect on Travel Plans	All (N=668)	State				Region	
		DE (N=230)	MD (N=177)	VA (N=127)	NC (N=133)	Coastal (N=271)	Inland (N=385)
I would still visit the area but would change some of the activities I had planned while there[1]	32	38	26	29	31	35	29
I would go to another coastal area unaffected by *Pfiesteria*[2]	29	26	28	28	39	24	33
I am unsure how it would affect my travel plans	17	17	20	20	11	15	19
I would keep my original plans to visit the coastal area[2]	11	9	15	14	8	16	8
I would no longer go to that coastal area, but would stay home	6	6	5	7	5	6	6
I would change my travel plans and visit a non-coastal area	5	4	7	2	6	4	6

*Totals may not equal 100% due to rounding
[1]Significant differences observed among state residents at .01 level of significance.
[2]Significant differences observed between regional residents at .01 level of significance.

Pfiesteria and Seafood Safety

When the study participants were questioned about whether they had heard reports that seafood was unsafe to eat because of *Pfiesteria* outbreaks, 63% responded they had heard such reports, 14% responded that they were "unsure," and about one-quarter (23%) indicated they had not heard any reports. Those who responded in the affirmative were further asked if they thought it was safe to eat seafood from an area where an outbreak had occurred if it were properly handled and prepared. Only 24% responded "yes," 45% responded "no," and 31% responded that they were "unsure" (Table 13).

Those individuals who indicated they eat seafood were asked whether they had changed or would change their eating habits because of *Pfiesteria* concerns. To obtain answers to this question, they were asked whether they generally knew the area where their seafood was caught. Of those respondents who ate seafood, about one-third (31%) responded that they generally knew where their fish was caught, 12% responded they were "unsure," and slightly more than one-half (51%) responded that they did not know where their fish was caught (Table 14). Only 6% of the respondents indicated they did not eat seafood.

The respondents who replied they did eat seafood were asked if they had avoided buying or eating seafood from restaurants or markets within the previous five years based on information they had heard about *Pfiesteria.* Only 20% of respondents overall indicated that they had avoided buying or eating seafood during that time period. A follow-up question asked seafood eaters whether a *Pfiesteria* outbreak in their state would cause them to reduce their consumption of seafood from their state's waters. Fifty-eight percent responded that they would reduce their consumption, 23% responded that they were unsure how they would react, and less than one-fifth (19%) reported that they would not reduce their consumption of state-harvested seafood because of a *Pfiesteria* outbreak (Table 15).

State Comparisons. Respondents from each state were fairly consistent in their responses to whether they had heard reports that seafood was unsafe to eat. Delaware (68%) and Maryland (64%) residents indicated they heard reports more often than Virginia (59%) or North Carolina (58%) residents, although no significant differences were observed (Table 13). Significant differences were noted with regard to knowing where their seafood was caught. North Carolina residents (41%) reported greater knowledge about where their seafood was caught than other state residents (between 28% and 30%) (Table 14).

There were also significant differences noted among the various state residents regarding seafood avoidance because of information presented about *Pfiesteria.* Twenty-three percent of Delaware residents and 22% of Maryland residents reported that they had avoided buying or consuming seafood, whereas only 11% of Virginia residents reported that they avoided buying or eating seafood. Statistical differences were also observed among state residents when they were asked if a *Pfiesteria* outbreak in their state would cause them to reduce consumption of seafood from state waters. More than two-thirds (69%) of Delaware residents reported they would reduce consumption, and 58% of North Carolina residents indicated they would limit their intake of seafood. Fifty percent of both Maryland and Virginia residents indicated they would reduce consumption of seafood (Table 15).

Coastal/Inland Comparisons. Coastal and inland residents reported hearing that seafood was unsafe to eat because of *Pfiesteria* at significantly different rates. Sixty-six percent of coastal residents and 63% of inland residents reported that they had heard such reports. Among those residents who responded affirmatively, a greater percentage of coastal residents (31%) than inland residents (19%) felt seafood harvested from an area where outbreaks had occurred could be eaten if it were properly handled and prepared (Table 13). As one might expect, more coastal residents than inland residents (42% versus

24%) knew the area where the seafood they eat is caught (Table 14).

More coastal residents (23%) than inland residents (18%) indicated that they had avoided buying or eating seafood in the last five years because of *Pfiesteria* concerns; however, this difference was not significant. On the other hand, responses from coastal (56%) and inland (59%) residents about reducing seafood consumption if a *Pfiesteria* outbreak occurred in the future were significantly different. A higher percentage of inland residents (25%) than coastal residents (18%) were unsure if they would reduce consumption (Table 15). See Appendix K for additional comments from state residents about reducing seafood consumption because of *Pfiesteria* concerns.

Table 13. Percent of Residents Who Have Heard Reports Seafood Is Unsafe to Eat or Safe to Eat if Properly Prepared, by State and Region[a*]

	All			State												Region					
				DE			MD			VA			NC			Coastal			Inland		
	(N=677)			(N=235)			(N=180)			(N=127)			(N=134)			(N=278)			(N=388)		
Heard reports that seafood is unsafe to eat because of *Pfiesteria* outbreaks[1]	Y	N	U	Y	N	U	Y	N	U	Y	N	U	Y	N	U	Y	N	U	Y	N	U
	63	23	14	68	20	12	64	24	12	59	28	13	58	22	19	66	25	9	63	21	16
	(N=416)			(N=156)			(N=114)			(N=72)			(N=74)			(N=179)			(N=233)		
Safe to eat seafood from area where outbreak had occurred if properly handled and prepared[1]	Y	N	U	Y	N	U	Y	N	U	Y	N	U	Y	N	U	Y	N	U	Y	N	U
	24	45	31	19	51	30	34	35	31	21	42	38	23	50	27	31	40	29	19	49	32

[a]Y=Yes; N=No; U=Unsure

*Totals may not equal 100% due to rounding.

[1]Significant differences observed between regional residents at .05 level of significance.

Table 14. Percent of Residents Who Are Aware of Where Seafood Products Are Caught, by State and Region*

Awareness of Where Seafood Is Caught	All (N=671)	State				Region	
		DE (N=228)	MD (N=181)	VA (N=128)	NC (N=133)	Coastal (N=277)	Inland (N=382)
Know area where seafood is caught[1]	31	30	28	30	41	42	24
Do not know area where seafood is caught[1,2]	51	53	54	51	42	39	60
Unsure about where seafood is caught	12	11	11	15	14	14	11
Do not eat seafood	6	6	8	5	3	6	5

*Totals may not equal 100% due to rounding.

[1]Significant differences observed between regional residents at .01 level of significance.

[2]Significant differences observed among state residents at .01 level of significance.

Table 15. Percent of Residents Who Have Avoided Seafood or Would Reduce Consumption, by State and Region[a*]

	All	State				Region	
		DE	MD	VA	NC	Coastal	Inland
	(N=633)	(N=216)	(N=167)	(N=120)	(N=129)	(N=261)	(N=361)
Percent who have avoided buying/ eating seafood in last 5 years because of *Pfiesteria*[1]	20	23	22	11	18	23	18
	(N=631)	(N=216)	(N=165)	(N=121)	(N=128)	(N=259)	(N=361)
Outbreak in state would reduce consumption of seafood from state waters[2,3]	Y N U	Y N U	Y N U	Y N U	Y N U	Y N U	Y N U
	58 19 23	69 12 20	50 26 24	50 18 32	58 24 18	56 24 20	59 16 25

[a]Y=Yes; N=No; U=Unsure

*Totals may not equal 100% due to rounding.

[1]Significant differences observed among state residents at .05 level of significance.

[2]Significant differences observed between regional residents at .05 level of significance.

[3]Significant differences observed among state residents at .01 level of significance.

Awareness of Other Marine Toxins

State Comparisons. When the study subjects were asked if they were aware of other toxins, bacteria, viruses, or organisms in ocean and bay waters that might be harmful to marine life, 42% indicated they were aware of some. These included things such as red or brown tides, oyster parasites, algae, and phosphates. See Appendix L for a listing of other responses mentioned by state residents. There were no statistical differences observed among state respondents; however, Delaware (45%) and Virginia (46%) residents were slightly more inclined to mention they were aware of additional toxins than North Carolina (37%) and Maryland (41%) residents (Table 16).

Coastal/Inland Comparisons. Coastal residents (46%) were more likely than inland residents (41%) to report that they were aware of other organisms that may affect marine and coastal waters; however, the differences were not statistically significant (Table 16).

Table 16. Percent of Residents Who Are Aware of Other Bacteria, Toxins, or Viruses in Ocean and Bay Waters, by State and Region

	All (N=695)	State				Region	
		DE (N=223)	MD (N=175)	VA (N=149)	NC (N=147)	Coastal (N=276)	Inland (N=404)
Percent aware of other bacteria, toxins, viruses in ocean and bay waters	42	45	41	46	37	46	41

Information Sources for Learning about Environmental Matters

A major objective of this study was to better understand how residents in the Mid-Atlantic region gain access to information about environmental matters like *Pfiesteria*. It is conceivable that residents form their impressions of the organism based on what they have read or heard from a variety of sources. When asked to report which sources of information they used regularly to learn about environmental issues affecting their respective states, television (90%) and newspapers (89%) were reported the most often. Listening to the radio (51%) was the only other source mentioned by more than one-half of the respondents. Magazines (37%), family/friends/co-workers (31%), and environmental groups (21%) were used to a lesser degree to learn about environmental issues (Table 17). Only 9% of the respondents mentioned that internet web sites provided them with regular environmental information, even though

54% reported that they had access to internet web sites from a home or office computer. Additionally, less than one-third (31%) reported that a computer was "very" or "extremely" important in helping to find information on environmental topics (see Table 19).

State Comparisons. As noted, newspapers and television were the most important sources of information for residents and individual state responses revealed little variation between these sources. Residents' selection of other information sources, however, did begin to reveal some variation. Maryland residents (59%) listened to the radio more often than other state residents (between 44% and 50%). Virginia residents (30%) were least likely to read magazines to get environmental information than residents of other states (between 36% and 42%). Virginians (22%) were also least likely to get information from family members, friends, or colleagues (between 30% and 36%), and this was the only source of information that revealed a significant difference among the states. Obtaining information from environmental groups (21%) and using internet web sites (9%) were the least used sources, and no differences were observed among the states (Table 17).

Coastal/Inland Comparisons. Significant differences were observed between coastal (92%) and inland (87%) residents with regard to obtaining information from newspapers. It is likely that local coastal newspapers report more often on environmental issues affecting the coasts than newspapers reaching inland audiences. Additionally, coastal residents (25%) were significantly more likely to obtain information from environmental groups than inland residents (18%) (Table 17). See Appendix M for a listing of other information sources mentioned by state residents.

Table 17. Residents' Primary Sources of Information on Environmental Issues, by State and Region (Values are Percentages)

Primary Information Source	All (N=729)	State				Region	
		DE (N=239)	MD (N=183)	VA (N=155)	NC (N=151)	Coastal (N=287)	Inland (N=426)
Television	90	90	91	86	91	91	89
Newspapers[1]	89	90	90	89	86	92	87
Radio	51	50	59	48	44	51	50
Magazines	37	38	42	30	36	36	38
Family, Friends & Co-workers[2]	31	36	32	22	30	34	28
Environmental Groups[1]	21	23	20	19	23	25	18
Internet Web Sites	9	10	8	9	11	8	10
Other	3	3	2	4	5	4	3

[1]Significant differences observed between regional residents at .05 level of significance.
[2]Significant differences observed among state residents at .05 level of significance.

Study subjects were further requested to indicate if they would use other sources of information if their regular information sources were not sufficient. Environmental organizations, public libraries, internet web sites, and state government officials each received between one-half and one-third of the responses from study subjects overall. University scientists (29%), local fishermen (28%), and university extension personnel (27%) all received a fairly consistent level of support. Federal government officials (14%) and family/friends/co-workers (13%) were the least used sources that respondents would contact for additional environmental information (Table 18).

State Comparisons. Significant differences were noted among state residents who indicated internet web sites would be useful as a secondary source for information. Delawareans (27%) were less likely to use this source than other state residents (between 41% and 43%). Delawareans (37%) were more inclined to seek information from university scientists than residents from the other states (between 24% and 28%) (Table 18).

Coastal/Inland Comparisons. Significant differences were detected among three information sources when regional comparisons were examined. Coastal residents noted a higher use of local fishermen (36% versus 24%) and university scientists (36% versus 24%) as secondary sources of

information than did inland residents. Inland residents (42%) were more likely than coastal residents (32%) to report internet web sites would be used as an alternate source of information (Table 18). See Appendix N for a listing of other secondary information sources mentioned by state residents.

Table 18. Residents' Secondary Sources of Information on Environmental Issues, by State and Region (Values are Percentages)

Secondary Information Source	All (N=691)	State				Region	
		DE (N=227)	MD (N=170)	VA (N=152)	NC (N=141)	Coastal (N=279)	Inland (N=400)
Environmental Organizations	49	51	48	48	48	47	50
Public Library	40	36	43	38	45	38	41
Internet Web Sites[1,2]	37	27	43	41	43	32	42
State Government Officials	33	39	33	30	26	37	30
University Scientists[2,3]	29	37	24	24	28	36	24
Local Fishermen[2]	28	29	31	24	31	36	24
University Extension Personnel	27	31	27	22	26	30	25
Federal Government Officials	14	17	11	15	12	14	14
Family, Friends & Co-workers	13	15	11	9	16	14	12
Other	2	3	1	1	2	3	2

[1]Significant differences observed between state residents at .01 level of significance.
[2]Significant differences observed between regional residents at .01 level of significance.
[3]Significant differences observed between state residents at .05 level of significance.

Access to The Internet

State Comparisons. More than one-half of all respondents (54%) reported that they had access to internet web sites for information (either at home or through their work). There were no significant differences observed among the states (between 51% and 58%). Only 31% of the respondents overall indicated that they thought computers were "very" or "extremely" important for finding information on environmental topics. No differences were detected among the states (between 29% and 35%) on this question (Table 19).

Coastal/Inland Comparisons. Inland respondents (58%) reported significantly greater access to the internet than coastal respondents (48%); however, both groups attached about the same level of importance to the internet as a means of finding information on environmental topics. Thirty-two percent of both coastal and inland residents found computers "very" or "extremely" important sources of information (Table 19).

Table 19. Percent of Residents with Access to the Internet and Importance of Computers, by State and Region

	All	State				Region	
		DE	MD	VA	NC	Coastal	Inland
Access to Internet	(N=728)	(N=236)	(N=181)	(N=158)	(N=152)	(N=287)	(N=425)
Percent reporting access to internet[1]	54	51	58	57	53	48	58
Importance of Computer	(N=393)	(N=117)	(N=106)	(N=89)	(N=80)	(N=139)	(N=245)
Percent indicating computers "Very or Extremely Important" in finding information on environmental topics	31	29	32	30	35	32	32

[1]Significant differences observed between regional residents at .05 level of significance.

CONCLUSIONS

The purpose of this study was to document the perceptions, attitudes, and behaviors of Mid-Atlantic residents in response to recent outbreaks of *Pfiesteria* along the mid-Atlantic coast. This type of information has been useful in the policy-making process and in determining effective public communication and outreach strategies. The findings presented in this report clearly demonstrate that *Pfiesteria* is well known to Mid-Atlantic residents and that their behavior following a toxic outbreak may have a significant impact on coastal communities.

The fact that almost 90% of all respondents indicated they had visited coastal areas in the Mid-Atlantic area for leisure during the previous five years (prior to 1998) suggests that they have some knowledge about the organism with the all of the media attention devoted to it. The primary activities these visitors engaged in could be affected by a *Pfiesteria* outbreak, especially eating local seafood products. Since more than three-quarters of respondents indicated they ate at seafood restaurants while visiting local beach communities, the potential economic impact on local commercial fisherman and seafood restaurants could be great if a toxic bloom occurred in a coastal resort community.

Overall, 93% of residents in the four states had heard of *Pfiesteria* even if they could not accurately explain what *Pfiesteria* was (responses were split almost equally among four selections). This lack of agreement by respondents on the nature of *Pfiesteria*, can suggest a number of things. First, as the media or other information providers report on the organism, they may not do a consistent job explaining what it is. Secondly, scientists or resource managers who are disseminating technical information, either directly to the public or through media sources, are not clearly articulating their messages. Thirdly, *Pfiesteria* is such a new phenomenon that the general public has yet to fully comprehend what it is and may be trying to relate it to other things in their experience. Finally, there may be any number of other plausible explanations to help understand the public's perceptions of this organism.

Even though a large majority of residents reported hearing about *Pfiesteria*, a significant proportion did not feel confident that they could make informed decisions about its impact on them, given their current level of knowledge. The degree to which residents sought additional information about *Pfiesteria* and its possible impacts was not tested, but the collected data seem to suggest a need for more, easily accessible information. Responses made clear that those surveyed believed strongly that

human activities were a main factor contributing to *Pfiesteria* outbreaks. Runoff from livestock and agricultural operations, along with pollution from factories and cities, were the most often cited responses to queries about the factors contributing to *Pfiesteria*. Relatively few respondents mentioned that they thought pollution from residential areas was also a significant factor. It is important to note, however, that many scientists and experts are still uncertain as to the exact causes of toxic outbreaks.

Survey respondents rated *Pfiesteria* as a serious environmental condition with a mean score of 3.8 on a 5-point scale. All but one of nine other coastal problem choices (e.g., water pollution, loss of wetlands, declining fisheries) were rated 3.0 or higher, thus indicating a high level of concern for many issues facing coastal areas. When residents further reported their concerns about *Pfiesteria*, it was notable that the greatest concerns were directed to the impact on living resources (animals could be affected and die) and the perception that *Pfiesteria* indicates too much pollution is going into local waterways. Lesser concerns (yet still important overall) focused on human health, economics, and impacts on seafood and water-based recreation.

Ninety-five percent of respondents were convinced that *Pfiesteria* is harmful to both living organisms in the water and ultimately to people. Sixty-four percent of the total sample believed eating seafood harvested from waters contaminated with *Pfiesteria* could harm humans, and 63% said they had heard reports that seafood was unsafe to eat because of *Pfiesteria* outbreaks. It is curious that so many people indicated they had heard seafood was unsafe to eat, since no evidence was found reporting this information. It is possible respondents perceived that they heard reports of this nature based on other information they have read or heard about.

It is also interesting to note that only one-quarter of respondents felt it was safe to eat seafood from an area where an outbreak had occurred, even if the fish were properly handled and prepared. Coastal residents seemed to have less fear about consuming seafood that inland residents, which could be due to being more aware of where the fish they consume is harvested. Among the various state residents, Marylanders indicated less fear overall about eating fish. This may indicate the effectiveness of proactive efforts undertaken in 1997 by the governor of Maryland and seafood marketing groups to educate consumers when *Pfiesteria* outbreaks in the state were impacting seafood sales.

Although only 20% of all respondents indicated that they had avoided buying or eating seafood in the previous five years (prior to 1998), more than one-half indicated that if a toxic outbreak were to occur in their state, they would reduce consumption of fish from their state's waters. This finding

suggests a critical need for additional consumer information, since nearly all of the fish affected during an outbreak are typically not "food fish." To date, health officials report no documented evidence that has confirmed any health-related effects from eating fish harvested from waters where *Pfiesteria* has been identified.

Pfiesteria outbreaks apparently can disrupt local economies, not only by causing reduced seafood consumption, but also by causing visitors to curtail travel to these coastal areas. One-third of likely visitors to coastal communities indicated that they would avoid certain activities if a *Pfiesteria* outbreak had recently occurred there. An additional 35% stated that they would either go to another coastal area unaffected by *Pfiesteria* or would stay home. While many of those that indicated they would not go to an area affected by *Pfiesteria* may ultimately end up vacationing there, it is worthy of note that over one-third of the sample responded on the survey that they would take precautions to avoid an area if an outbreak occurred. These findings can have major implications for tourism promotional agencies, such as chambers of commerce and visitor centers in Mid-Atlantic coastal communities. The need to plan communication strategies in the event of future toxic outbreaks becomes an important consideration for these groups.

Most respondents believed that the media had fairly and accurately provided information on *Pfiesteria*. Television and newspapers were the most often used method for keeping up on environmental events, with radio a distant third choice. The internet ranked far down the list with less than 10% of the sample indicating it as a primary source. Although this audience will likely grow quickly in the coming years (especially as a source of supporting information), TV and newspapers appear to have a strong hold as the most important sources for daily information. Environmental organizations are playing a larger role as a source of background and supplementary information on environmental issues, according to the survey respondents. Through either their printed or electronic material, a great deal of information on environmental subjects is readily available on-line or at local libraries. While this information often carries with it a certain degree of credibility among the public, depending on the organization, these materials may contain biased information. Prevalent use of such materials may also have some impact on how certain problems are perceived by the public.

According to survey respondents, their respective state governments have done a good job of handling local outbreaks. Further, most strongly support funding for *Pfiesteria* research and management initiatives. In the states where outbreaks have been the most prevalent (North Carolina and

Maryland), the responses are quite different. When initial outbreaks occurred in North Carolina, residents there did not feel government officials responded adequately (only about one-quarter). However, as outbreaks occurred in Maryland a few years later, almost one-half of the residents indicated they felt their state officials responded adequately. This may suggest that Maryland officials were better prepared due to North Carolina's earlier outbreaks, and more advanced planning was made with more scientific information available. North Carolina officials, however, did not have the benefit of this information and may not have been prepared to react as quickly.

There was substantial support for state government officials to continue to spend money to understand and help correct the problems caused by *Pfiesteria*. However, few residents (less than 30%) feel government officials are using the best scientific information to make decisions and may be more influenced by political pressure to act. This perception, no doubt, should change as more scientific inquiries reveal new information about the organism. Less than one-half of the respondents reported that they would trust the judgement of public health and environmental officials to re-open areas for recreation where an outbreak had occurred. This suggests that officials need to maintain open lines of communication with the public about their findings when monitoring for *Pfiesteria* and to insure that accurate information is disseminated in a timely manner. Few respondents overall reported contacting elected or state officials or attending public meetings about *Pfiesteria*; however, coastal residents did show a greater level of involvement in these activities than inland residents.

As expected, coastal residents are far more interested in the issue of *Pfiesteria* than inland residents. Although residents throughout each state are exposed to information on the organism, coastal residents seem to receive more intense, repeated information through local television, radio, and newspapers. Overall, public awareness of environmental issues has grown to a point where there is a fair level of sophistication among the general public about the complex interaction of nature's biological, chemical, and physical factors. This is made clear in the responses to survey questions about *Pfiesteria* and its causes. However, there also appears to be a need to make additional information easily available to all audiences. While this survey focused on the harmful algal bloom, *Pfiesteria piscicida*, the lessons learned could be applied more generally to other important issues and problems affecting coastal areas.

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APPENDIX A

MAIL SURVEY INSTRUMENT

SURVEY ON COASTAL ISSUES IN THE MID-ATLANTIC REGION

Sea Grant

University of Delaware ◆ Sea Grant Marine Advisory Service
700 Pilottown Road ◆ Lewes, DE 19958-1298

THE FOLLOWING QUESTIONS WILL HELP US UNDERSTAND THE COASTAL AREAS YOU VISIT AND WHAT ACTIVITIES YOU LIKE.

1. Have you visited beaches, bays, or coastal areas within your state, or other states in the mid-Atlantic region (from New York through North Carolina), for pleasure in the last 5 years? ○ YES ○ NO → If NO, go to question #3

   If YES, which state's beaches or coastal areas did you visit? (**Select all that apply**)

   ❑ New York Coast ❑ New Jersey Coast ❑ Delaware Coast
   ❑ Maryland Coast ❑ Virginia Coast ❑ North Carolina Coast

2. What activities do you typically engage in while visiting these areas? (**Select all that apply**)

   ❑ Swimming/Beach activities ❑ Boating/Sailing ❑ Fishing
   ❑ Clamming ❑ Crabbing ❑ Eating at seafood restaurants
   ❑ Buying local seafood ❑ Visiting nature areas ❑ Other (specify) _____

QUESTIONS 3 - 6 RELATE TO COASTAL ISSUES OF IMPORTANCE IN THE MID-ATLANTIC REGION.

3. Have you heard of **Pfiesteria** (pronounced *fis-teer-ee-ah*)? You may have seen pictures or read reports about Pfiesteria as causing sores on fish, and even killing them. ○ YES ○ NO → If NO, go to question #19

4. Would you say that Pfiesteria is primarily: (**Select only one response**)

   ○ A form of pollution ○ A predator that attacks fish
   ○ A disease in fish ○ A parasite in fish
   ○ A toxin or poison ○ Other (specify) _____

5. Do you think Pfiesteria can be harmful to people? ○ YES ○ NO

   If YES, how do you think Pfiesteria harms people? (**Select all that apply**)

   ❑ It harms the environment, which indirectly can harm people.
   ❑ It can harm swimmers or waders in the water.
   ❑ It can harm people if they eat seafood.
   ❑ Fishermen in boats can be harmed if they touch fish or the water.
   ❑ It's in the air and can harm people if they are in the area.
   ❑ Other (specify) _____.

6. Please tell us what concerns you the most about Pfiesteria? (**Rank your three most important concerns by placing the number of the item in the appropriate space below**)

   1. Marine animals can be affected and die.
   2. It can affect my health if I come in contact with it.
   3. It can indicate that too much pollution is going into our waterways.
   4. There can be economic losses to people making their living on the water.
   5. It can affect water-based recreational activities that I like to engage in.
   6. It can affect the seafood I like to eat.
   7. Other (specify)_____

   Most Important: _____ Second Most Important: _____ Third Most Important: _____

NEXT, WE WOULD LIKE TO KNOW HOW YOU THINK YOUR STATE IS RESPONDING TO THE ISSUE OF PFIESTERIA?

7. To your knowledge, have outbreaks of Pfiesteria occurred in your state's coastal waters?
   ○ YES ○ NO ○ UNSURE

8. If Pfiesteria outbreaks have occurred in your state, do you think your state government officials have responded adequately?
   ○ YES ○ NO ○ UNSURE

   Please comment on your state's actions: _____

9. What conditions do you feel contribute to Pfiesteria blooms in your state? (**Rank your three most important concerns by placing the number of the item in the appropriate space below**)

   1. Over-fertilizing lawns or failing septic systems from residential homes.
   2. Pfiesteria occurs naturally and is not caused by human activity.
   3. Pollution from factories and industry.
   4. Runoff from crop farming.
   5. Stormwater drainage or sewage plant discharges from cities and towns.
   6. Livestock farming practices (e.g. chicken, pigs, cows).
   7. Other (specify) _____

   Most Important: _____ Second Most Important: _____ Third Most Important: _____

10. Have you ever contacted an elected official about the Pfiesteria issue?
    ○ YES ○ NO

11. Have you ever contacted an employee of your state natural resource agency or public health agency about the Pfiesteria issue?
    ○ YES ○ NO

12. Have you ever attended a public meeting or public hearing about the Pfiesteria issue?
    ○ YES ○ NO

THE NEXT SERIES OF QUESTIONS ARE IMPORTANT TO KNOW HOW YOU FEEL ABOUT CERTAIN ISSUES RELATED TO PFIESTERIA.

13. If you made plans to visit a beach or coastal area (for pleasure) and heard that there was a Pfiesteria outbreak, how would it affect your travel plans? (**Select only one response**)

    ○ I would no longer go to that coastal area, but would stay home.
    ○ I would still visit the area, but would change some of the activities I had planned while there.
    ○ I would go to another coastal area unaffected by Pfiesteria.
    ○ I would change my travel plans and visit a non-coastal area.
    ○ I would keep my original plans to visit the coastal area.
    ○ I am unsure how it would affect my travel plans.

14. Have you heard reports that seafood is unsafe to eat because of Pfiesteria outbreaks?
    ○ YES ○ NO ○ UNSURE

    If YES, from what you have heard do you think it is safe to eat seafood from an area where an outbreak has occurred if it is properly handled and prepared?
    ○ YES ○ NO ○ UNSURE

15. If you eat seafood, do you generally know the area where the fish was caught?
    ○ YES ○ NO ○ UNSURE ○ I DON'T EAT SEAFOOD → If you don't eat seafood go to question #18

16. Have you avoided buying or eating seafood from restaurants or markets within the last 5 years because of information that you have heard about Pfiesteria?
    ○ YES ○ NO

17. Would a Pfiesteria outbreak in your state reduce your consumption of seafood from your state's waters?
    ○ YES ○ NO ○ UNSURE

    Please comment: _____

18. LISTED BELOW ARE SOME STATEMENTS ABOUT PFIESTERIA. PLEASE RATE YOUR LEVEL OF AGREEMENT OR DISAGREEMENT WITH EACH OF THE FOLLOWING STATEMENTS BY CIRCLING THE RESPONSE THAT COMES CLOSEST TO HOW YOU FEEL.

(**SD**=STRONGLY DISAGREE; **D**=DISAGREE; **U**=UNDECIDED; **A**=AGREE; **SA**=STRONGLY AGREE)

Newspapers, magazines, and TV have done a good job of informing me about Pfiesteria without creating too much fear.	SD	D	U	A	SA
Pfiesteria occurs naturally in the marine environment and humans have little or no control over preventing outbreaks.	SD	D	U	A	SA
I feel I have enough knowledge about Pfiesteria to make informed decisions that affect me.	SD	D	U	A	SA
Residential/commercial development can cause Pfiesteria outbreaks in coastal waters.	SD	D	U	A	SA
Money being spent by my state government to understand and help correct any problems caused by Pfiesteria is a good investment for my state's future.	SD	D	U	A	SA
Agricultural runoff can cause Pfiesteria outbreaks in coastal waters.	SD	D	U	A	SA
If public health and environmental officials say it is safe to swim, boat, or fish where a Pfiesteria outbreak had previously occurred, I would trust their judgement.	SD	D	U	A	SA
Science, not politics, forms the basis for decisions that are made in my state about Pfiesteria.	SD	D	U	A	SA

QUESTIONS 19 - 23 FOCUS ON YOUR UNDERSTANDING OF ENVIRONMENTAL ISSUES IN GENERAL.

19. Are you aware of any other toxins, bacteria, viruses, or organisms in ocean and bay waters that might be harmful to marine life?

○ YES ○ NO If YES, give the names as best you can remember them: _____

20. On a scale of 1 to 5 (with 1=Least Serious and 5=Most Serious), rate how serious you perceive each of the problems listed below are to your state's coastal areas: (**Please circle the number that corresponds to your response**)

	Least Serious				*Most Serious*
Declining Fisheries Resources	1	2	3	4	5
Population Growth in Coastal Areas	1	2	3	4	5
Red or Brown Tides	1	2	3	4	5
Shoreline Erosion	1	2	3	4	5
Water Pollution	1	2	3	4	5
Loss of Wetlands	1	2	3	4	5
Rising Sea Level	1	2	3	4	5
Pfiesteria	1	2	3	4	5
Chemical and Oil Spills	1	2	3	4	5
Dredging	1	2	3	4	5
Other (specify)_____	1	2	3	4	5

21. Where do you regularly learn about environmental issues affecting your state? **(Select all that apply)**

1.❑ Newspapers 2.❑ TV 3.❑ Magazines 4.❑ Radio 5.❑ Friends/Family/Co-workers

6.❑ Environmental Organizations 7.❑ Internet Web Sites 8.❑ Other (specify) _____

Of the above mentioned information sources, please rank your top three by writing in the number that corresponds to your selections:

First Source: _____ Second Source: _____ Third Source:_____

22. If you wanted more information on environmental issues and the above-mentioned sources were not sufficient, where else would you look? **(Select all that apply)**

❑ State Government Officials ❑ Federal Government Officials

❑ Public Library ❑ University Scientists

❑ University Extension Personnel ❑ Local Fishermen

❑ Friends/Family/Co-workers ❑ Environmental Organizations

❑ Internet Web Sites ❑ Other (specify) _____

23. Do you have access to an internet web site from a home or work computer?

○ YES ○ NO

If YES, how important is a computer in helping you find information on environmental topics?

❑ Not at all Important ❑ Slightly Important ❑ Moderately Important ❑ Very Important ❑ Extremely Important

The next few questions will help us better understand you and your background. These responses will be kept strictly confidential.

24. What is your occupation?_____

25. Are you, or is someone in your immediate household, employed in a job related to the marine waters of the mid-Atlantic (e.g. commercial fisherman, seafood buyer/seller, charter boat captain, marina operator)?

○ YES ○ NO If YES, please describe: _____

26. What is your age? _____

27. What is the highest level of education that you have completed?

❑ Grade School ❑ Some High School ❑ High School Graduate

❑ Some College ❑ College Graduate ❑ Post Graduate Education

28. Are you? ❑ Female ❑ Male

29. Do you belong to an environmental organization such as the Sierra Club or Audubon Society?

○ YES ○ NO If YES, please specify: _____

30. Which bests describes your total annual family income, before taxes?

❑ Under $10,000 ❑ $10,000 - 19,999 ❑ $20,000 - 29,999

❑ $30,000 - 39,999 ❑ $40,000 - 49,999 ❑ $50,000 - 74,999

❑ $75,000 - 99,999 ❑ $100,000 & above

Is there anything else you would like to share with us?

_____

_____

_____

Thank You for your cooperation.

Please return the completed survey in the stamped, self-addressed envelope provided.

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Sea Grant University of Delaware

Sea Grant
College Program

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Fall 1998

Dear Coastal State Resident:

Did you know that in the United States over one-half of the country's population lives near the coast? Even if you do not live along or visit the shore, you still live in a coastal state and are influenced by happenings along the shore. 1998 has been declared the Year of the Ocean to highlight and increase understanding of this relationship between people and the ocean.

The University of Delaware Sea Grant College Program is conducting a study to discover what opinions mid-Atlantic state residents have about some important coastal issues. Your name has been randomly selected as a representative coastal state resident. Before you put this survey aside believing this does not affect you, remember that input from individuals like yourself is needed to guarantee that those with a sincere interest are heard when far-reaching decisions about the coasts are made.

The accuracy of this study depends on the number of questionnaires returned, so every one is important! It should only take about 10 minutes to complete. Once you have answered all the questions, simply place the completed questionnaire in the enclosed postage-paid envelope and return it to us. Any information you provide will be strictly confidential. Your name will never be placed on the questionnaire or reported in any way. In addition, once you complete this survey you will not receive any more mailings from us in the future.

Once again, your opinions are very important in defining issues and identifying solutions. We greatly appreciate your interest and help with this study.

Sincerely,

James M. Falk
Project Coordinator

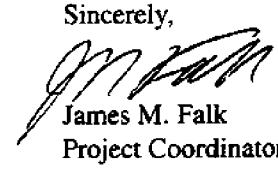
Dear Coastal State Resident:

About a week ago you should have received a questionnaire seeking your opinions about some important coastal issues affecting your state. At the time this postcard was mailed, we had not yet received your response. Your answers are very important and will be used to represent the opinions of many other residents with views similar to yours.

We would greatly appreciate it if you would take a few minutes to complete the questionnaire and return it in the postage-paid envelope we provided. If you have misplaced the questionnaire, or did not receive it, we will send you another one if we do not hear from you.

Thank you for your time and cooperation.

Sincerely,



James M. Falk
Project Coordinator

Note: If you have already completed and returned the questionnaire, please disregard this reminder. Thank you for your prompt response.

Sea Grant UNIVERSITY OF DELAWARE

SEA GRANT
COLLEGE PROGRAM

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Hugh R. Sharp Campus
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E-Mail: James.Falk@mvs.udel.edu

Fall 1998

Dear Coastal State Resident:

About three weeks ago, you were sent a questionnaire as part of a study to gauge mid-Atlantic residents' views on some recent coastal issues of note. If you have already returned it, we thank you for your prompt response. If you have not yet completed the questionnaire, would you please take the time to do so now? It should only take about 10 minutes.

The information gathered from this study will benefit all residents of your state, not just those living along the coast. Currently there is little information on how people like yourself feel about these issues, yet decisions that affect your daily lives are being made regardless. There are no right or wrong answers, but this is your opportunity to make your viewpoint known.

We would like to remind you that if our results are to be as reliable and useful as possible, it is important that each questionnaire be completed and returned. Remember, all responses will be summarized and handled in strict confidentiality.

A copy of the questionnaire and reply envelope are enclosed in case you did not receive, or have misplaced the original materials we sent to you. After you have completed the questionnaire, just seal it in the postage-paid envelope and drop it in any mailbox.

Your time and cooperation are greatly appreciated.

Sincerely,

James M. Falk
Project Coordinator

APPENDIX B

COASTAL COUNTY SAMPLING FRAMEWORK

COUNTY SAMPLING FRAMEWORK

Delaware Counties Sampled (N=200)

- Sussex

Maryland Counties Sampled (N=200)

- Dorchester
- Somerset
- Talbot
- Wicomico
- Worcester

Virginia Counties Sampled (N=200)

- Accomack
- Essex
- Gloucester
- James City
- Lancaster
- Middlesex
- Northampton
- Newport News
- Surry
- York

North Carolina Counties Sampled (N=200)

- Beaufort
- Bertie
- Chowan
- Craven
- Dare
- Hyde
- Pamlico
- Tyrrell

APPENDIX C

ENVIRONMENTAL GROUP MEMBERSHIP

QUESTION 29. DO YOU BELONG TO AN ENVIRONMENTAL ORGANIZATION SUCH AS THE SIERRA CLUB OR AUDUBON SOCIETY? (SPECIFY ORGANIZATION)

Delaware Responses

- Audubon Society (7)
- Sierra Club (4)
- Ducks Unlimited (4)
- Nature Conservancy (3)
- Waterfowl USA (2)
- Delaware Nature Society (2)
- National Wildlife Federation (2)
- Wildlife Society (2)
- National Parks and Conservation Association
- National Wild Turkey Foundation
- Yosemite Association
- James River Association
- Arbor Day Foundation
- National Rifle Association
- Greenways
- Izaak Walton League of America
- Delmarva Coon Hunters Association
- Used to work for an environmental firm

Maryland Responses

- Chesapeake Bay Foundation (5)
- Nature conservancy (5)
- Ducks Unlimited (3)
- Audubon Society (2)
- Arbor Day Foundation (2)
- National Wild Turkey Federation
- Natural Resources Defense Council
- MD Natural History Society
- Chesapeake Bay Alliance
- National Wildlife Federation
- Horsehead Wetlands Center
- Natural Resources Defense Council
- Greenpeace

Virginia Responses

- Audubon Society (3)
- The Nature Conservancy (3)
- Save the Bay (3)
- Sierra Club (2)
- Greenpeace
- Izaak Walton League of America
- National Wildlife
- Chesapeake Bay Foundation--York Chapter
- National Parks and Conservation Association

North Carolina Responses

- Audubon Society (5)
- Sierra Club (3)
- Pamlico Tar River Foundation (3)
- National Wildlife Federation (3)
- Nature Conservancy (3)
- Ducks Unlimited (2)
- Local River Foundation
- Volunteer for Environmental & National Wildlife Conservancy (student action)
- National Parks & Conservation Association
- Friends of Wildlife
- World Wildlife Fund
- Neuse River Foundation
- St. Lawrence - Save the River
- Hyde County Waterfowl Association
- NC Wildlife Federation
- NC Recreation & Parks Society
- National Recreation & Parks Association
- National Wild Turkey Federation
- North Carolina Trappers Association
- Wildlife Heritage Alliance

APPENDIX D

EMPLOYMENT RELATED TO MARINE ENVIRONMENT

QUESTION 25. ARE YOU, OR IS SOMEONE IN YOUR IMMEDIATE HOUSEHOLD, EMPLOYED IN A JOB RELATED TO THE MARINE WATERS OF THE MID-ATLANTIC? (DESCRIBE JOB)

Delaware Responses

- Son is flood plain engineer and daughter in-law is EPA engineer
- Marine biochemist
- Diesel boats mechanic
- Water quality analyst
- Merchant Seaman
- At one time, operated vessels from New York, Cape May, Norfolk, Savannah, Key West - even Boston and Gulf of Mexico.
- Charterboat captain

Maryland Responses

- Family holds a commercial crabbing license in MD (Chesapeake Bay crab pots)
- Wife is environmental attorney with U.S. Army Corps of Engineers
- Commercial crabbers and marina operators
- Seasonal employee of a Delaware State Park on the coast
- Charter captain
- Waterman/charterboat captain
- Crabber

Virginia Responses

- Offshore oil and gas
- Navy
- Coast Guard
- Marina owner
- Recreational crabber

North Carolina Responses

- Commercial fisherman (4)
- Marina operator
- Seafood seller/buyer
- Bridge & Ferry Division maintenance
- Striped Bass Fish Hatchery Personal
- Food microbiology (shellfish sanitation, environmental microbiologist)
- Family members (uncles & cousins) commercial fishermen

APPENDIX E

IMPORTANT COASTAL ISSUES MENTIONED BY RESIDENTS

QUESTION 20. ON A SCALE OF 1 TO 5, RATE HOW SERIOUS YOU PERCEIVE EACH OF THE PROBLEMS LISTED BELOW ARE TO YOUR STATE'S COASTAL AREAS. (OTHER PROBLEMS MENTIONED)

Delaware Responses

- Sewage Discharge (3)
- Quality of city sewage disposal plants
- Trash from boats and tourists
- Loss of habitat
- Lack of concern by people and government until it affects them
- Pollution (plastic rings, plastic bags)
- Over-population
- Chicken manure
- Environmental groups looking for press
- Commercial fishing
- Sewage and medical trash showing up in our waters
- Unknown/unauthorized sewage discharge to ocean
- Agriculture/chemical runoff
- Stop all building anywhere near water
- Inadequate sewer treatment
- Wildlife
- Irrational environmentalists
- Industrial growth
- Dumping of everything in the ocean
- Enforcement of laws and regulations on commercial and residential codes and violations
- Apathy
- Too many "foreigners"
- Harvesting of horseshoe crabs
- Phragmites growth
- Overpopulation of snow geese
- City sewer - runoff - hog farms
- Over harvesting commercially of all seafood
- Rubbish, garbage, etc.
- Over development in Sussex County

Maryland Responses

- "Personal watercraft"--Jetskis
- Extinction of fish species
- Neglect in my mountain area that ends in the bay waters
- Dumping in the ocean.
- Recreational boating toilet waste
- Non-point pollution
- Town sewage disposal

- Other activities or careless actions that cause pollution, etc
- Loss of watermen
- Dumping sludge
- Too many surveys and state and government money being spent on something that nature will take care of; notice you have not heard of any outbreaks since the temperature of the water has gotten cooler
- Lack of public awareness
- Overfishing
- Law enforcement
- Too much development
- Sewer dumping
- Lack of cooperation between Virginia, Maryland and Delaware on crabbing and fishing (should be limited for recreational persons)
- Pollution by big business

Virginia Responses

- Declining crab population due to over fishing (2)
- Environmental controls that do not make sense but are enacted to accommodate the environmental lobby; the environmental lobby does not have my best interest at heart
- Overbuilding on shore
- Drift nets
- Lack of care for the environment, greed of builders and government officials
- Citizen apathy
- Overfishing the Bay
- MSX and Dermo
- People will go to any lengths to get grant money including lying about facts and trying to scare the population
- Navy pollution

North Carolina Responses

- Politics
- Military dumping trash in the sea off boats.
- Waste disposal
- Two many surveys - not enough work on problem.
- Beach erosion
- Loss of marine life
- Hog waste
- Holding tank pumpout
- Beach erosion
- Hurricanes
- Chemical & oils from roads & channelization of waterways, increase farm runoff.
- Netting of fish too close to shore.
- The favoritism shown to commercial fishermen, in the allocation of allotments of a public owned natural resource, (i.e., fish, shellfish, crabs) by the National Marine Fisheries Service & the Atlantic States Marine Fisheries Commission

APPENDIX F

RESIDENTS' PERCEPTIONS OF *PFIESTERIA*

QUESTION 4. WHAT WOULD YOU SAY THAT *PFIESTERIA* IS PRIMARILY? (OTHER RESPONSES)

Delaware Responses

- Organism that produces toxin (2)
- Fish killing microorganism
- My understanding is that it is a parasite that feeds off the pollution - in turn affects our fish; Parasite (sores) on fish
- A bacteria that attacks fish; Bacteria is out of normal proportions because of pollution, (i.e., nitrates from chicken manure runoff)
- *Pfiesteria* is a potentially toxic dinoflagellate, a photosynthetic organism that produces a strong toxin
- Plants that take on animal characteristics
- Too much phosphorous in water
- A microbe that attacks fish
- Bacterial growth
- An organism
- A disease from poison
- Microbe

Maryland Responses

- Chicken manure (2)
- A killer
- Possible caused by farm runoff
- Bacteria in water
- Carelessness in environment control (i.e. boats, marina runoffs)
- Answer is based on public articles
- A natural solution to over population of fish
- Virus
- Outcome of the disturbance in the ecological balance caused by mankind interference and greed
- Organism

Virginia Responses

- A vine that chokes off oxygen
- I think it is a natural organism that has been altered into a parasite by exposure to toxins and pollutants that have been dumped in the water by man
- Protistan - flagella
- A form of pollution that is a toxin/poison that causes disease in fish
- Pollution that causes fish to decay
- I have yet to see definitive evidence for any one of the above

North Carolina Responses

- Bacteria (2)
- Toxic organism
- Bacterial infection
- Parasite in water
- It is disease that attacks fish that is a byproduct of pollution
- Disease attacks fish, humans & poison & toxin
- An organism present in water which causes mutations on fish plus other problems
- Pollution
- Water born toxin
- Micro organism
- Naturally occurring dinoflagellate

APPENDIX G

RESIDENTS' PERCEPTIONS OF HARMFUL NATURE OF *PFIESTERIA*

QUESTION 5. DO YOU THINK THAT *PFIESTERIA* CAN BE HARMFUL TO PEOPLE? (OTHER RESPONSES)

Delaware Responses

- Direct contact with a fish that has *Pfiesteria*
- If it harms fish, it could people
- Harms incomes because of inaccurate diagnosis by biased environmentalists
- Only by lengthy repeated exposure to the material itself
- In certain situations where someone may have an open wound or sore

Maryland Responses

- Not sure - need more proof
- Much is not known yet
- I think it harms people in several of the above ways, plus it needs more research to find out how else it harms
- Can harm people if they eat affected seafood
- I find toxins/poisons to be rather "burdensome" all around
- Prolonged contact to water containing *Pfiesteria*

Virginia Responses

- Don't know, but it does affect food chain
- I believe it will harm anything in the water that it comes in contact with

North Carolina Responses

- It's affecting the marine food chain
- Fish kills
- Most cases, it's terminal
- Harmful to the economy
- It makes all fish harmful for food if infected with *Pfiesteria*
- Short half-life toxin (neurotoxin) in water only (and for short time)
- Industry and city discharge into rivers
- If you eat the fish with *Pfiesteria*
- If you eat too many meals of fish

APPENDIX H

RESIDENTS' PERCEPTIONS OF CONDITIONS CONTRIBUTING TO *PFIESTERIA*

QUESTION 9. WHAT CONDITIONS CONTRIBUTE TO *PFIESTERIA* BLOOMS IN YOUR STATE? (OTHER RESPONSES)

Delaware Responses

- All of the above (3)
- Some weather or adverse temperatures may contribute to the problem
- City septic systems too old to handle increase in population and tourists
- I don't feel any of these have been proven. It may be a national phenomena,
- Sewage plants, after being cleaned and treated needs to be checked
- Poultry raising, farm practices using chicken manure for fertilizer
- Garbage people throw in ocean
- We also still dump waste in our waters by the State
- Lack of rain let nutrients concentrate
- Drought, little water movement

Maryland Responses

- No one really knows
- Wildlife
- Poultry industry waste
- Farming
- Pollution from citizens in waters
- Housing development
- Tributaries feeding bay
- Poor water movement
- Upsetting ecological balances

Virginia Responses

- Navy ships
- I am not sure and I think there are many questions - no answers
- Draining rivers when in a drought
- Science is not sure of cause
- Unknown causative factors

North Carolina Responses

- Sewage plant discharge. Raleigh, Cary, Kinston - Neuse River Basin - NC
- I do not think the cause has been definitely identified
- Legal chemical discharges linking to other legal chemical discharges downstream
- Red Tides, oil spills, etc.
- We have River Keepers watching the rivers
- Weather conditions: hurricanes, flooding, drought

- Low oyster population
- Lack of enforcement of Clean Water Act

APPENDIX I

RESIDENTS' CONCERNS ABOUT *PFIESTERIA*

QUESTION 6. WHAT CONCERNS YOU THE MOST ABOUT *PFIESTERIA?* (OTHER RESPONSES)

Delaware Responses

- All of above (2)
- My dad likes to body surf and *Pfiesteria* can ruin it
- Environmentalists use misinformation to scare the public
- Traces, not outbreaks in Delaware

Maryland Responses

- All are important
- Over reaction by news media about something that has probably been around for thousands of years
- It can be economic losses of poultry farmers also
- Affect environment
- Food chain - micros - human
- "News"

Virginia Responses

- Do not eat fish with sores
- Lack of true scientific studies as to cause

North Carolina Responses

- All of the above are serious concerns
- Can affect property values
- Mammals such as muskrat and mink could be declining because of *Pfiesteria*
- Its occurrence in the Mid-Atlantic has triggered a political involvement that may ultimately impact the economy of the region

APPENDIX J

RESIDENTS' RESPONSES TO STATE GOVERNMENT'S ACTIONS

QUESTION 8. IF *PFIESTERIA* OUTBREAKS HAVE OCCURRED IN YOUR STATE, DO YOU THINK YOUR STATE GOVERNMENT OFFICIALS HAVE RESPONDED ADEQUATELY? (COMMENT ON STATE'S ACTIONS)

Delaware Responses

- Moved too slowly
- Stopped swimming at beaches
- They are trying to
- Poultry industry runs DE
- No effective program to control agricultural runoff
- Afraid to offend chicken industry
- I know the authorities have been following it
- Contacted polluters
- State is monitoring water and checking reports of fish with sores
- Too many political and personal concerns
- Warning people not to eat contaminated fish
- Power house discharge not enough
- I don't want knee-jerk decisions
- Have done sampling
- Not sure about Delaware, we are near MD and have watched their reactions
- They talk about it
- Need basic studies to indicate cause
- Dodges the issue
- Waters are full of manure
- I don't think enough is done for long term protection of our water
- They have done what they could without chasing out the poultry industry
- Annual analyses are being done
- I know they have closed certain areas periodically; I'm not sure that's enough
- The state has monitored waterways and warned residents of outbreaks, but could do more to solve the underlying problem of poor water quality
- With regard to outbreaks in MD I think all states that have bad problems don't seem to have done that much about preventing further spreading
- Monitoring - ok. Addressing cause - poor
- I'm sure they would act immediately
- Nothing factual - hearsay and newspapers
- Most states take too long to react to problem
- They do not know the cause and are too quick to blame farmers (poultry growers)
- Notification of an outbreak inland when coastal waterway recommendations not to swim or ingest fish or shellfish during outbreak
- Seems to be downplayed
- Propaganda aimed at tourists
- They're aware but obviously not dealt with cause because it is still occurring

- Chicken industry is huge in Delmarva and sanctions against could be devastating against economy, thus state is reluctant to take drastic measures
- Have heard warnings
- What has the state done
- They continue fishing
- They have been doing a very good job
- DE was looking for ways to stop the disease
- Remains to be determined
- Closing affected areas
- Survey has been conducted
- Stop using or eat fish in that water until it clears
- They do a good job
- They are not sure of the cause
- Unsure really - no one really knows enough to judge
- Hosted multi-state conference
- Don't know of any Delaware response
- Stop chicken manure, but they are giving them too much time
- The states first concern is "dollars" and "tourism"
- Studying problem - working with farmers to change practices
- I know they have taken some action but I don't know what it was
- They are reacting to biased information
- Trying to find out cause
- Too easy on fertilizer regulations on farm and home
- There has been testing of the fish and areas that have been affected
- Outbreak in DE was several years ago
- They are accusing poultry pollution as a cause before any tests were done with the final results
- Lack of legislation regarding chicken manure
- Investigating the link between *Pfiesteria* and farm runoff
- Poor - did testing - took no action
- Help to focus research efforts to find out more about the problem
- Pollution still occurs
- UD marine college at Lewes has tested
- State government aggressively passed new laws
- Researching what causes *Pfiesteria*
- Found what was killing fish
- Use of chicken manure should have stopped
- Political/financial football with poultry industry
- Require nutrient plans for agri-businessmen (alum on the soil/documentation of use of chemicals and poultry manure

Maryland Responses

- Too slow (3)
- It had high level attention
- We still need to follow through on pollution

- State of MD (and DE) is beholden to the chicken industry on the eastern shore (i.e. Perdue) and can't effectively limit waste runoff/dumping from chicken processing
- State should hold individuals totally responsible for runoff
- Maryland is still hiding the problem
- Government is responding but problem still exists
- Closed affected water
- There was a quicker response than NC and it was admitted that it affected humans - but perhaps more info. and quicker action for research could have occurred
- Prompt
- Closed river to use
- From the western end of the state, very little information or coverage
- Worked with North Carolina to determine cause and cure
- Believe they are concerned and are pursuing corrective measures
- They have studied the fish and water - closed waterways when necessary
- Public was aware very early
- They have tested and retested
- Actions are being taken to alleviate the problem
- Chicken runoff addressed
- Not tough enough on polluters
- Took action after studying issue
- Over reaction without good science facts
- Probably over reacted
- Slow to respond
- There was a lot of quick talk but we don't hear about it now
- Test waters, no more signs of *Pfiesteria*
- Consulted with relative state agencies and private industry, alerted the public
- Over reacted
- More needs to be done
- Banned fishing in affected areas
- I don't know the present situation
- They are trying to clean up the bay
- Slow response and then not enough
- Very aggressive steps to prevent
- Need to find reason for *Pfiesteria* by further study
- They are testing waterways and restricting fishing in affected areas
- Informed the public
- Investigations
- Will not set guidelines for recreational boaters; How many slips can be built, etc.
- They spend money joy riding on boats and do nothing
- Fairly prompt, informative
- They have done what they can, based on current knowledge
- Medical research into human exposure syndrome
- They are taking too extreme measures
- If they think it comes from chicken manure, they need to ban the spread of it on fields and see if that helps solve the problem
- Monitoring waters, new regulations

- Knee jerk reaction - First denying the problem then trying to force regulations without facts
- Next to none
- Put rules on something they know nothing about (on farmers)
- Political issue
- In trouble
- Testing, study work
- Done studies - put a check on land waste and fertilizers from animal waste
- Out of control governor
- On the job
- Making public aware
- Governor Glendenning took appropriate action
- Think MD responded better than NC and VA

Virginia Responses

- State has addressed this problem, am not sure if they are serious about it
- No state government response required. No reported outbreak in VA that I'm aware of
- VA reaction was slow and politically correct
- Government is reactive, not proactive - usually too little too late
- Too much hysteria - not enough study
- They have run studies to see how to cure it
- I think it's been checked carefully
- Investigations influenced by biased political actions
- Somewhat
- Decrease dumping of pollutants (i.e., fertilizers/chicken farm runoff)
- Monitoring the rivers
- They proclaim the area is not infected
- Just warning to public - don't eat
- I belong to Isaac Walton League of America. I do believe there is a recognition of the problem
- Closed waterways
- I only know what I have seen on the news
- I think VA found some, but they let the people know
- Tried to find the source
- Enough will be done when the problem is solved
- Kept people informed of the problem. Reviewed and studied and made recommendations
- I think VA is good at ensuring that all that could be done will be done
- Studying problem
- Probably no
- This is handled by news media before the officials know about it
- They thought we did and took quick action
- Closed rivers
- More controls need to be placed on the poultry industry
- This governor seems to respond only to the whims of the religious right
- Need to enact some laws and help financially
- They have sent scientists to conduct research in our waters
- Politics got involved resulting in questionable pseudo scientific studies

North Carolina Responses

- Slow to respond (3)
- They have been slow but are improving
- N.C. State University - rapid response teams
- A lot of talk - all that politicians do
- No word
- Not enough research into what is being dumped into the water
- Not enough funding to tackle problem
- Testing
- They haven't made any actions that I know of
- Committee action taken
- They still let industries/city sewage dump in water
- Arguments among state and school
- Appropriated tax payers money to hire one Ph.D. to do nothing
- They're tested but I don't know of any follow up actions
- Politics overriding concerns
- They should have been checking out the water 10 years ago
- Only a few scattered reports, never a follow up
- Need more funds available for research
- For some time our state officials would not believe it
- Count the dead fish
- Politicians ignoring scientific findings
- Lack of toughness on root cause - afraid of economic impact of shutting down root cause (i.e. being short sighted)
- They're working on it
- Do nothing but collect taxes
- They are researching it, but slowly
- N.C. primarily reports the occurrence and then does nothing to prevent future occurrences
- Response too slow, but improved
- Lack of action
- But it took a long time for action
- It's like they don't care that it can harm humans
- Establishment of rapid response team
- NC was slow early on but has now come into mainstream
- More research to stop *Pfiesteria* from releasing toxins
- They had started clean-up
- They are working on it
- Investigating cause
- Dr. Burkholder of North Carolina State is studying this, she is an expert
- Officials only seem to see money when it comes to chickens or hogs in NC
- Too much time wasted talking
- They discredit reports that people studying fish with *Pfiesteria* developed problems (i.e., rash, illness)
- Media news and posted signs
- NC hasn't taken as much action as MD

APPENDIX K

RESIDENTS' COMMENTS ABOUT REDUCING CONSUMPTION OF SEAFOOD

QUESTION 17. WOULD A *PFIESTERIA* OUTBREAK IN YOUR STATE REDUCE YOUR CONSUMPTION OF SEAFOOD FROM YOUR STATE'S WATERS? (COMMENTS ABOUT SEAFOOD CONSUMPTION)

Delaware Responses

- Determined by information provided as to non-contamination of seafood
- Who would not
- I ask where it is from, prefer products from Maine and Canada; stay away from frozen products from China, South America and Mexico
- Eat mostly fish from fresh water where *Pfiesteria* is not a problem; 90% of fish I eat I've caught and cleaned myself; do not eat raw or undercooked fish, so feel safe in what I eat in restaurants
- Buy fish that is not from our state
- Until it is definitely known the effects of consuming this type of disease, I'd be hesitant to eat these fish
- Prefer ocean fish, but if it spreads, I would alter my diet
- Depends upon location and size of outbreak
- Although there have been outbreaks, I do not skip seafood because it does not seem to me it is widespread enough to warrant this level of concern
- It if would affect my health, yes
- I only eat shellfish and tuna
- If told not to eat seafood, I would comply
- Was told to ask in a restaurant where seafood came from; if given an answer, still not sure
- I usually don't eat anything from the Rehoboth Bay
- If I knew seafood was from Delaware waters, I wouldn't buy it
- Cooking may kill the bacteria, but I am not sure what is safe
- It would depend of the severity of the outbreak
- It would worry me what seafood I would serve to my family
- *Pfiesteria* may not be harmful to people who eat seafood but it certainly doesn't make me feel that I want to take the chance
- Confident sellers would not sell fish with *Pfiesteria*
- You would check where *Pfiesteria* was present and avoid that area
- I would find out where (what part of state) the outbreak is and not purchase seafood or eat it from that area. If it's the whole state then I wouldn't eat at all
- As long as safeguards screened out potentially harmful fish
- Not enough data on toxicity
- Would probably avoid local bay fish
- I would not eat the fish I caught if the area was affected; I would not even fish
- Try to eat deep sea fish
- Rather be safe than sorry
- Unless I knew they came from an area where there was no known outbreak
- Until it is reported ok to consume the seafood
- I would become more selective
- Unless guaranteed seafood was not from an effected area
- Residual affect to us all

- I only eat fish in the spring season that I catch myself
- Better safe than sorry
- I feel fish with *Pfiesteria* would not be sold for food consumption
- I assume all seafood is properly inspected
- If the outbreak was in an isolated area and not statewide
- If I knew that the fish had come from my states waters
- Don't eat the disease
- I would not be affected unless told otherwise
- Maryland seafood was greatly hurt 2 years ago
- It's a great health issue/concern; Who knows if death may occur to humans; Look what DDT did and we still haven't recovered, we may never
- I rarely eat non-ocean fish
- Just the area affected
- For aesthetic reasons and possibly health concerns
- It would have a high effect - no one would come to our area and us that are here would leave
- Consumers would not want to eat seafood from this state
- We do not care to eat the seafood from the waterways where *Pfiesteria* is present or where these fish have migrated
- Most definitely

Maryland Responses

- There are plenty of options available to use, so why risk eating seafood of questionable quality during a media frenzy
- As a truly unknown quantum, I would be safe by not indulging
- Consume mostly shellfish
- From restaurants; My brother and neighbors catch fish which I continued to eat
- Better safe than sorry
- In general the Chesapeake Bay ongoing pollution reports have given me much pause and avoidance of its seafood in last 5 years
- I wouldn't consume any seafood
- All food has to be inspected (I hope)
- Although not big fish eaters, we would cut back on the fish we do eat that's local
- No conclusion available as to safety
- We do not fish in waters where an outbreak is reported
- I would not eat the type of seafood that was affected
- *Pfiesteria* was found on the eastern shore of Maryland and I live on the western shore, has not stopped my fishing and boating in my area
- If you don't want to be sick, you won't eat seafood
- Although I am told it is safe to eat, the *Pfiesteria* problem reminds me of other pollution related problems with our seafood and causes me to eat less seafood; I don't think we are aware of all the problems
- Because of the outbreak, I have become more cautious of the seafood I eat; I have also limited the amount
- Probably depends on which seafood and when I heard it was affected in relation to my consuming it

- Need to have more information on the subject
- Until the cause is determined, I'm not sure runoff is the cause; More study required
- People tend to be generally concerned about all the seafood
- I don't think bad seafood would be made available
- Uncertainty would make me cautious
- I feel safe in the fact the waters are closely monitored
- Feel confident that infected seafood would not be served in my area
- Only the seafood reported affected
- If it were local
- I don't like to eat toxins
- I really don't know about *Pfiesteria*, or if it affects people
- Because I'm not sure what's causing it, I will limit my consumption
- My family and I would stop eating 1 to 3 bushels of blue crabs every other day
- If it is shown that proper cooking would kill the *Pfiesteria* and wouldn't harm you then I would consume it
- Depends on any DNR or health department warnings
- Dependent on the severity of the incident and the effect on the actual fish
- Could possibly affect my health
- Perhaps I have too much faith in the seafood industry to deliver untainted wholesome seafood

Virginia Responses

- Would not feel comfortable if it was local fish
- Would want to know the source of the supply
- I would buy food from other areas
- I buy very little seafood
- Depend on study results
- Depends on statements made by officials regarding safety
- I eat fish from local fish pond on farm
- Better safe than sorry
- Not enough scientific evidence yet to point to a reason
- I would not eat any seafood with Navy ships dumping oil, sewage and who knows what else
- Feel we don't have enough knowledge about *Pfiesteria* - more research needed
- If possibly harmful, I am not going to eat it
- Would need more cause and effect information, not speculation
- I probably would not check to see from where it came
- Why take a chance
- Why eat anything that might, or could, harm you
- I would be cautious about my purchases of seafood and buy from people whom I could trust
- I would need more information about the effects on humans; Without knowing, I would avoid seafood from those areas
- Only if it occurred where I get my seafood
- I believe infected fish are culled from the catch
- I stopped buying fish when I heard it was found in Virginia
- I would be more selective about what I ate
- Don't know where seafood comes from

- I would not eat local catches and shellfish
- I need more information (data) to make an informed decision
- I need more information
- I heard that *Pfiesteria* can effect you if you eat fish that have it and I would avoid fish out of those waters
- Would need to know more about it

North Carolina Responses

- Would not eat in those areas
- We eat very little seafood now as opposed to our former habits
- If aware of origin of seafood
- I would not feed my family food if I wasn't sure it wouldn't harm them
- It depends on whether or not it affects the type of seafood I enjoy to eat
- Due to the uncertainty regarding the impacts of *Pfiesteria* on seafood quality, most people would still consume
- I would not eat the seafood because I do not know what has actually caused *Pfiesteria*
- No use in taking chances
- North Carolina has the only barrier island estuary in the U.S. and it's highly contaminated - also has *Pfiesteria*
- If caught in ocean waters
- If you use common sense and don't eat seafood that has signs of disease and prepare the food properly, I believe there is no threat to your body
- It depends where precisely the outbreak occurred
- Never know where the food comes from
- Depends on how large an outbreak and where; There has already been an "outbreak" in my opinion
- I would take extra care to know where the fish was caught
- I would not eat seafood
- Responsible people and restaurants would be sure the seafood served by them would be safe
- I know who gets the seafood, they are trustworthy (local)
- If seafood is handled and cooked properly, then I have no problem with it
- I would be afraid to feed it to my family and myself
- Only neurotoxin is harmful to humans (Burkholder is using this issue to advance her career)
- Will not eat local seafood while outbreak is ongoing
- I don't wish to harm myself
- Don't eat a lot of seafood
- Better safe than sorry
- We have had an outbreak in our river "Neuse." I would not eat seafood from the river, but would from "clean" locations
- Not sure if it is safe and it doesn't look good
- Not until I was sure how it would affect me
- If touching a fish can cause problems, I definitely wouldn't consume fish where there is an outbreak
- Fish that have sores — I have released back into the water I don't no why; should take home and burn, might be better

- I would prefer eating seafood from another area; same as in oysters and red tide
- I would want more details
- Should an outbreak be acknowledged, it would likely cause a closure of that area to fishermen of which I am one

APPENDIX L

MARINE-RELATED TOXINS, BACTERIA, OR VIRUSES MENTIONED BY RESIDENTS

QUESTION 19. ARE YOU AWARE OF ANY OTHER TOXINS, BACTERIA, VIRUSES, OR ORGANISMS IN OCEAN AND BAY WATERS THAT MIGHT BE HARMFUL TO MARINE LIFE? (OTHER RESPONSES)

Delaware Responses

- Red Tide (29)
- PCB (7)
- Brown Tide (5)
- Mercury (4)
- Oil Spills (4)
- E coli (3)
- Pollution (3)
- Human waste (3)
- Raw sewage (3)
- Fecal coliform (2)
- Chicken manure (2)
- Algae (2)
- Acids (2)
- Heavy metals (2)
- Pesticides (2)
- Excessive temperature discharge
- Alkalids,
- High BOD
- Lack of oxygen
- Lead
- Clam area posters
- Hepatitis
- Something in oysters
- Dermo
- MSX in Shellfish
- TBT
- Halognated hydrocarbons
- Cholera
- Alexandrium (PSP)
- Fertilizers
- High nitrogen, nitrates.
- Chemicals
- Trash, commercial dumping,
- Medical waste
- DDT
- Phosphates
- I don't know specific names, however, I have read that the Indian River and Bay is one of the most polluted bays in the country

Maryland Responses

- Red Tide (14)
- Dermo (4)
- Algae blooms (3)
- MSX (2)
- E coli (2)
- Phosphates (2)
- The 2 oyster diseases
- Hepatitis
- Brown tide
- Heavy metals
- Vibrio
- Worms in fish
- Oyster parasite (DMX)
- Garbage
- Industrial waste
- Nitrogen
- Zebra mussels
- How about all the toxins our own military dumps in the water (Coast Guard)
- I'm taking a parasitology course so any number of parasites
- Some shore homes have a sewage problem

Virginia Responses

- Red Tide (11)
- Kepone (3)
- Oyster disease (3)
- Navy ships (2)
- Oil spills (2)
- Hospital waste and needle dumping
- Commercial drainages & farming chemicals and lawns.
- MDX (oyster killer)
- DDT
- Waste outlet
- Garbage dump
- Parasites
- PCB's
- Phosphates
- Virus X
- Mercury
- Sewage
- Toxins
- General pollution
- Organisms affecting oyster population specifically
- Bacteria in oysters

- Fecal coliform bacteria
- Toxic waste from big companies that dump in rivers, etc.
- E coli
- Material from dumps
- Pollution from factories
- Chemical pollutants
- Litter
- Industrial
- Septic tanks

North Carolina Responses

- Red Tide (27)
- Brown Tide (3)
- Dioxin (3)
- Trash/Garbage (3)
- Metal dumping (2)
- Mercury (2)
- Chromium
- Lead
- Phosphate
- Fungi like Aphanomyces
- Carbon
- Fertilizers
- Phosphates
- Agent Orange
- Plastics
- Oyster organisms
- Oyster virus
- There is no telling what has been dumped in our oceans.
- Paralytic shellfish poisoning
- Algae
- Stuff farmers dump
- Vibrio
- Hepatitis
- Chemicals from paper processing
- Sewage from yachts
- Water pollution
- Chemicals
- Oil spills
- Contaminated oysters and clams
- Viruses from farm raised shrimp
- Feces

APPENDIX M

RESIDENTS' PRIMARY SOURCES OF INFORMATION ON ENVIRONMENTAL ISSUES

QUESTION 21. WHERE DO YOU REGULARLY LEARN ABOUT ENVIRONMENTAL ISSUES AFFECTING YOUR STATE ? (OTHER RESPONSES)

Delaware Responses

- All of above (2)
- Fishing organizations
- State publications
- Presentations
- It's my job
- Resident - 51 yrs.
- The Fisherman Magazine

Maryland Responses

- Television (2)
- Father-in-law is a waterman
- Lectures & seminars
- Government information and scientific publications

Virginia Responses

- Izaak Walton League of America
- Coastal Heritage magazine from South Carolina Sea Grant

North Carolina Responses

- North Carolina Sea Grant
- Local university
- Fishing magazine
- Students/teachers at my school
- Local fishermen
- UNC-Charlotte School of Public Health Doctoral program
- My contacts with the university system.
- Nature centers
- First hand experience

APPENDIX N

RESIDENTS' SECONDARY SOURCES OF INFORMATION ON ENVIRONMENTAL ISSUES

QUESTION 22. IF YOU WANTED MORE INFORMATION ON ENVIRONMENTAL ISSUES AND THE ABOVE-MENTIONED SOURCES WERE NOT SUFFICIENT, WHERE ELSE WOULD YOU LOOK? (OTHER RESPONSES)

Delaware Responses

- Scientific journals (2)
- Fishing and boating publications
- Call Environmental Protection Agency
- The Fisherman Magazine

Maryland Responses

- Delaware State Parks
- Check it out first hand

Virginia Responses

- Virginia Institute of Marine Science
- Department of Natural Resources

North Carolina Responses

- Science teachers at my school
- Christian universities
- We have a "River Keeper" and Neuse River Foundation working on our problems
- My personal observations and experiences

APPENDIX O

ADDITIONAL SURVEY COMMENTS

Additional Survey Comments

Delaware Responses

- We like fishing, crabbing, and swimming and also just love the beach all the time.
- Believe people could be harmed by eating raw or undercooked seafood; avoid touching fish with sores, carry soap to wash hands immediately if touch accidently; I fish extensively both fresh and saltwater all over the state of DE, catch from 800 to 1100 fish per year, most of which I release. Most years I never catch a fish with sores (except for a few that have been previously hooked and are healing). I try different streams every year and have never found one without healthy fish in it. It irritates me when some public officials and environmentalist talked about half the streams or more being devoid of life. I see many problems that need rationale decisions, not all these false statements that people make. I see signs of progress and improvements. We need marine studies and communication, not false alarmists.
- I love the ocean, I wish that others would become more concerned about our ocean lands, etc. I guess I understand more because my family has been exposed to chemicals from my husbands workplace; he is now deceased because of this and my family (some) have health problems as a result of this and not one would listen to us.
- Power houses clean tubes with something. I've seen dead fish after and they blow the tubes after dark so you can't see it, but I have found it on my car.
- No just keep working for clean bays and oceans; restrict PWC to a specific area of bay so rest of area is free of lack of care about other people or illegal re-fueling in bays.
- Would love to get the right scientific minds involved with the politicians to enforce the laws governing pollution in waterways, etc. thru out the state and make better laws.
- Are there opportunities to become involved in marine projects. I have a Ph.D. degree in biochemistry and 30 years of industrial experience.
- Have suggested before that there are ways to clean out our waters.
- A review of current crabbing harvest controls - no females for next year if saving them would improve future harvest.
- It's great you sent this out it shows that the scientists are concerned and maybe if people respond and you get better feedback you may be able to affect the politicians.
- I spend every weekend from April to October on my sailboat on the Rehoboth Bay. I am greatly concerned with runoff from poultry plants. Like most Delawareans, I don't really understand *Pfiesteria*. I continually read the information and it seems to always be a debate.

- Like to help - personal involvement, perhaps employment at Lewes.
- *Pfiesteria* on Eastern Shore indicates it is time to do something about chicken farm practices, especially controlling nitrogen runoff. It is my understanding that cost to do so might be in order of cents/lb. Of chicken, not a large cost for the consumer.
- Sample for chemicals (mercury, cadmium, etc.) In Lewes and Rehoboth sewer outfalls. Prepare dispersion charts based on tides and above data.
- Beach restoration should continue; our coastline is precious and vital.
- Business and resident need to take responsibility for environment. Government needs to put out facts to support this. Self policing is the answer.
- Should be more cooperation between local government and federal. Also, university scientists, extension personnel, the local fishermen and the environmental organizations to share information and work out a sensible solution.
- Increasing population equals increasing pollution and increasing pressure on our natural resources. Coastal areas need to be better protected from over development.
- Whenever something is found being wrong done it should be taken care of immediately especially on commercial sites or be shut down. We should have more people monitoring for pollution.
- I'm a subscriber of a magazine called The Fisherman. They keep me and my friends very informed about what's being done to help our marine environment.
- My only hope is that your decisions become based on science, fact, "what's right" - not what's good politics.
- Boats are biggest polluters.
- I was taught at home school and with the Boy Scouts about keeping America clean and to be very proud of that, "I sure am" and still do keep it clean. Americans need a wake-up-call on how important and fragile our environment is. A federal and state program is needed to instill that pride back in Americans, starting at home, school, church, etc. Please stop the dredging of crabs in Delaware and the rest of the nation.
- Last fall while fishing I would catch 1 in 8 or 9 croakers with lesions on them. Also I caught 2 flounder with the same.
- Stop misleading the public. Stop using naturally occurring environments to scare the public into funding extremist organizations such as Sierra Club and the Bay Foundation.
- Help stop development in this state. They are killing it.

- I am always concerned about anything affecting our beaches, seafood and wetlands. I am a native Eastern Shore resident and pride myself on our heritage.

- I am afraid that some of the "Greens" do more harm than good with their radical and extreme positions and proclamations. For example, some endangered species "protectionism" has made the basic problem worse, not better.

- We really enjoy the ocean and bay coasts.

- Maryland seems ahead of Delaware in its legislation passed regarding nutrient runoff and control of waste from chicken industry.

- I'm filling this out for my father - everyone in my household is concerned with these issues. Something must be done before it's too late.

- Delaware, in resort areas, plays down all negatives so that tourism is not affected. I'm sure Delaware is not only state to do this but it is wrong.

- I feel the farmers have been wrongly accused of contributing to *Pfiesteria*. The public should know of the great strides the farmers have made to protect the environment. Most of these efforts started before the *Pfiesteria* problem started.

- Until something is done to control our factories, farms, industry from using our waterways as dumping ground, there will be outbreaks such as *Pfiesteria* and others that haven't been discovered yet.

- Yes, why do most industries have locations near waterways? Wake up. Money, money. That's why and the government hasn't the guts to put a stop to it! You asked and you already knew.

- Some watermen are not reporting *Pfiesteria* that they see which only adds to the problem.

- We often wonder about the correlation between cancer and the poultry industry in Sussex County.

Maryland Responses

- We need to fix the problems we have created or else our children will continue to be threatened with life-threatening illness and the beauty of our coastal waterways.

- *Pfiesteria* is a symptom of declining overall ecosystem health and the public at large seems concerned only during the active local outbreaks. This questionnaire seen to be hanging a lot on the *Pfiesteria* hook, and while public concern is acute during outbreaks, the situation requires ongoing attention during non-critical times.

- Throwing money at a problem doesn't solve it.

- Although I am +3-1/2 hours from tidewaters, the pollution in the Chesapeake Bay worries and concerns me a good deal. Thank you!
- Maintain the integrity of the Critical Areas Act and actions. Also, the wetlands definition and protection.
- Even though I am not educated on our *Pfiesteria* problem other than what news reports have revealed to the public live in Maryland, I feel that I should be. I have answered all questions the best that I could with very limited knowledge on *Pfiesteria.*
- I am a fisherman, crabber, and clammer and camper. Let me know what you find out.
- I have very little respect for information put out by farmers and watermen.
- The public needs more information on what *Pfiesteria* is, what the dangers are and how this environmental occurrence can be minimized or prevented.
- I have neighbors that make a living as watermen and conversations with them keeps me up-to-date on how these issues affect their living standards.
- How come MD doesn't do a survey like this and include the seafood industry along with poultry processors/land owners?
- Long time area resident (Maryland); second home (Delaware); Seafood lover; frequent beach areas.
- The public is generally uninformed concerning most environmental problems. More information is needed for the education of most.
- I think the environment and its well being is a very important topic.
- I do not know much facts about the issues presented here. Most of it is hearsay and journalism. They are not issues I have personally investigated.
- After the first sensations the news media doesn't follow-up - no one agrees as to what causes these problems - you don't hear what is being done about it.
- Our state needs to look at new housing developments with all the overdone yards with chemicals. Don't blame the farmer - where will your food come from if you keep forcing new regulations on us and forcing us out.
- Why is it necessary for a taxpayer to inform those who are earning enormous salaries and benefits, how to accomplish a solution? If they have no talent, why were they chosen? It is a ridiculous situation!

- This environmental problem is subjected to the usual political activity. It is folly to think that, to determine the cause and necessary action, all you have to do is get together with a group of selected experts and boat around talking about.

Virginia Responses

- To spend public money on environmental programs not in accord with a defensible set of priorities is likely to do more total harm than good (e.g. money spent on air quality cannot be spent on water quality).
- Primary concern is the pollution of the rivers and the Chesapeake Bay.
- The North Carolina Sea Grant is great. Dr. Lundi is a great person.
- 1. Our polluted waters must be cleaned up. 2. Stop cutting down our forests. 3. Stop truck and car pollution (emissions).
- Our state political leaders do not remain neutral on issues concerning *Pfiesteria*. They politically side with poultry industry, biased politics.
- My house is 10 feet from Elizabeth River in Portsmouth, Virginia.
- Most of the seafood I eat comes from the gulf off Charleston, S.C. I have a friend that fishes commercially.
- Thank you for asking me to participate in this survey. Although I am a conservationist and environmentalist, I feel I am not versed enough on these subjects to consider myself qualified to take part in this survey.
- I can see from the above the areas I came from the clean up that is being done along our waterways. Just doesn't start with the water, our surrounding land should be kept clean too to reduce waste materials washing down to our waterways. My father was a commercial fisherman. I have concern for this industry, taking too many fish too fast out of the water.
- Since I own a condo at Surfside Beach, S.C., I am very interested in safe water for swimming and for the seafood we consume.
- Over-development and wetland destruction are very serious environmental problems in the mid-Atlantic coastal area.
- I would like to see oysters like they used to be. Make hand tonging only way to catch oysters.
- I wish Virginia would care as much as Maryland and stop pretending this is not happening.
- I would like to learn more about *Pfiesteria* and other challenges to the health of the Chesapeake Bay.

- When I put a check in box #27, that means that I have not yet finished my high school education. I am in the 11th grade. Thank you for sending this questionnaire. It was very interesting.

- I would prefer information regarding *Pfiesteria* sent to me.

- Pollution cleanup from all military bases should be strictly enforced. I used to work at Langley AFB. Seemed pollution controls were not enforced or adhered to sometimes

- My mom didn't want to fill this out, so I did. Hope you can read it. Thank you very much for letting me have my feelings known. The reason I filled out is because this is very important to me. I wanted to become a marine biologist so water is very important to me.

North Carolina Responses

- As some of the questions are closed ended for a distinct answer - some may be partially true in each different individuals case. Thank you!

- This doesn't just affect economic issues, quality of life is also involved. Eastern NC is economically poor to begin with, but it used to be a safe environment to raise children, now residents are leaving the area for both reasons. It's past time to take a closer look at the allowable chemical discharges and how they react to each other.

- I hope my answers help.

- Pollution from hog farms and leaking city sewage is the most pressing issue in North Carolina.

- Take action to help the environment.

- I don't really think N.C. government does enough to even attempt to clean up the Cape Fear River or any wetlands for political reasons or they really too busy letting real estate companies run things for big bucks.

- The fishing industry is very important to us in Dare Co., NC, especially on Roanoke & Hatteras Islands. This and our tourist economy are our biggest employers. The health of our beaches and waterways is something we want to protect. My school - Cape Hatteras Secondary - is active in this effort. Please contact me if you would like to learn more about our programs.

- I think there is a problem with *Pfiesteria* in our coastal waters caused most naturally but, some from industry. A bigger problem is the politics and money surrounding the whole issue and blowing it out of proportion.

- Science is more important than hearsay or political solutions to complex biological problems.

- I think people should take care of our coastal areas. We really need them.

- Thanks for caring!

- Thank you so much for including me in your study. I try in many ways to care for my environment and no matter how small. I wish everyone would respect their environment. Action speaks louder than words!

- I'd like to now know what *Pfiesteria* is. You've peeked my curiosity and it sounds very critical.

- If you are trying to find out whether the general public is aware of the severity of the virus or not, I don't think they do know. We have what is known as river keepers. I don't know if they are paid by the county, state or federal government or if they are just volunteers. They are dying like flies. If you ask a local commercial fisherman about the virus, you will normally get the answer, "Naugh, dees fish be alright" and he will have sores on the visible parts of his body. I don't know if the virus has always been, or whether it is a mutation of another, the State of North Carolina has historically been an agricultural state, primarily tobacco, corn and beans. Beginning in the early seventies animal husbandry started to escalate at a very rapid pace. Menhaden fish are the species in which the virus is dominate began to appear in the late seventies. You may find a sore on other species once so often but it's rare. They feed by filtering water through hairlike follicles in their mouth. Industry, town's and farmers do not have to pollute, it's a matter of money. To upgrade systems to a point there will be no pollution cost money. Industry, towns and farmers want the tax payer to pay for it. Environmental agencies allow each one to pollute certain amounts by permits. In recent years the state of North Carolina appropriated money to hire a lady Ph.D. to study the virus. I don't know who she reports to, but reports to the public by media has been little to nil. I was reluctant to answer your request. Thanks.

- I feel that the sores my oldest daughter gets has been caused by *Pfiesteria* - (the sores leave really ugly scars and take a long time to heal) from swimming in the river (Chowan).

- I live on the Trent River which runs into the Neuse River. I feel the problem is years of sewage plant and farm runoff has put too much nitrogen and chemicals in the water.

- The control of *Pfiesteria* is crucial to keeping our fishermen and water sports enthusiasts healthy. However, keeping our waters clean from pollution, either from accidental waste dumping or controlled waste disposal, should be given priority also.

- The consensus appears to be that *Pfiesteria* comes and goes. Let's study it some more and be aware of its potential to cause problems and avoid the worst ones.

- Use common sense.

- Being in the recreation field, I am very interested in this subject as it affects the quality of life in my town which is very water-based.

- In drainage canals of Beaufort Co., 25 years ago, I caught many bream, catfish and even pike (2-1/2 lbs.). Now that is not possible, can you help. Let's fix the small problems first, maybe the large ones will not be so large.

- Question #9 - I was thinking of something I read in US News & World Report concerning pollution in the Chesapeake, that oysters filter out pollution.

- The commercial exploitation of our fisheries allowed by the National Marine Fisheries Service has got to cease. You could help but I suspect your funding and support is directly tied to commercial and industrial interest. Feel free to send any other surveys including the results of this one as I thoroughly enjoyed putting forth my 2 cents worth.