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The Human implications of Pfiesteria: The Eastern Shore of Maryland and the impacts of a toxic dinoflagellate bloom on the culture, health, and economics of a community.

The Eastern Shore of Maryland has a distinctive community that derives a great portion of its livelihood through agriculture on the land and in the water. The toxic dinoflagellate bloom of *Pfiesteria* in 1997 caused attention to be drawn to nutrient practices on farms and had a significant impact on the people residing in and making a living off of the Eastern Shore. Harmful algal blooms have given rise to a closer examination of the relationship between the Eastern Shore farmer and waterman way of life and the effects of the culture on the environment. An important aspect regarding the *Pfiesteria* outbreak of 1997 that must be examined is how it affected the culture, health, and economics of the community of the Eastern Shore of Maryland.

An extensive amount of research has been done concerning the physical environmental impacts of the *Pfiesteria* outbreak that occurred in the Chesapeake Bay watershed in 1997. The Eastern Shore, in many areas, has relied traditionally on land agriculture and fishing as a way of life. A disruption such as the toxic dinoflagellate *Pfiesteria* greatly impacts that way of life. As Paolisso and Chambers (2001) point out, "...toxic dinoflagellate blooms can have profound economic and political consequences for nearby human communities. Since the outbreak, "...the organism[s] biological- and health-threat potential [have] captured human attention and imagination" (Paolisso and Chambers, 2001, p. 2). While physical environmental impacts are undeniably significant to the study of *Pfiesteria*, there are also human and cultural impacts that have occurred and effected the Eastern Shore of Maryland as a result of the outbreak. This paper will first briefly examine the environmental impacts of *Pfiesteria* and then continue with a

more in depth discussion of the culture of the Eastern Shore, the health implications, and the economic impacts.

Though it has previously been stated that the human impacts of *Pfiesteria* are integral to examining the entire impact of the outbreak, one needs to first understand the biology and physical science of this toxic dinoflagellate. *Pfiesteria* is a single-celled marine microorganism that can have more than twenty different forms throughout its life. Included in the stages is a vegetative toxic form that releases a neurotoxin in the presence of fish. Fish are immobilized and the *Pfiesteria* consumes the outer flesh causing lesions and often death (Paolisso, 1999, p. 53). *Pfiesteria* cannot photosynthesize independently but can function as a viable plant by consumption of chloroplast-bearing algae and has the ability to adapt to changing food and nutrient availability (Paolisso & Maloney, 2000, p. 210). The ability to adapt helps the dinoflagellate to survive in a number of conditions and it especially thrives in its toxic form under specific temperatures and nutrient levels. An overabundance of nutrients present in water creates eutrophication of the water body, which leads to a high level of algae. The high level of algae present, along with said nutrient and temperature qualifications, lead to ideal conditions for an outbreak of *Pfiesteria*.

Watermen, or commercial fishermen, began to notice lesions and erratic swimming behaviors of fish located in the Pocomoke River of Maryland in autumn of 1996. While this event went relatively unnoticed on a public scale, the numbers of fish with aforementioned symptoms began to rise in 1997 (Grattan et al., 1998, p. 532). Over a four-day period in August of 1997, between 10,000 and 30,000 lesioned and/or dead fish were discovered in the lower Pocomoke River that runs through Worcester and

Somerset counties. State and local officials issued a public health warning and closed off public access to certain affected areas by the second day due to water samples testing positive for the toxic form of *Pfiesteria* (Paolisso, 1999, p. 53). The dinoflagellate was found in a total of three tidal rivers that summer on Maryland's Eastern Shore of the Chesapeake Bay, which raised concerns over the regions water quality and agricultural nutrient runoff practices, to be addressed later in this paper.

The culture of the Eastern Shore of Maryland has been undeniably intertwined with the issue of *Pfiesteria* in light of the outbreak of the dinoflagellate's toxic form in 1997. The three counties that comprise the lower Eastern Shore of Maryland: Wicomico, Worcester, and Somerset, are among the most poverty-stricken in the state (Paolisso & Chambers, 2001, p.8). The traditional occupations that have been supported in the region for decades are agriculture and fisheries, though they have been declining in recent years. The Pocomoke in particular has long supported fishing and crabbing by Eastern Shore watermen. The issue of pollution in the Chesapeake Bay watershed is not a new concern to the residents and governing forces of the Eastern Shore. The agricultural community of the area has long recognized the need to reduce loss of nutrients from farmland and the outbreak of the toxic dinoflagellate brought attention to how serious the problem had become.

The *Pfiesteria* outbreak focused much of the blame for decreased water quality as well as nutrient contamination to farms, especially poultry farms. Numerous outsiders to the farming community, such as urbanites and government officials, began to see farmers as unconcerned polluters (Paolisso, 1999, p. 53-54). Many farms on the Eastern Shore do have problems with nutrient runoff and this has been highlighted throughout the

discussions of *Pfiesteria* that have occurred since its occurrence in the Pocomoke. “In the Pocomoke watershed, an important source of aquatic nitrogen and phosphorus is runoff from nearby farms that either raise and/or use poultry manure to fertilize crops” (Paolisso, 1999, p. 54).

Farmers on the Eastern Shore of Maryland have for decades supplemented crop production by contracting out to large poultry industry companies such as Tyson, Perdue, and Mountaire to raise broiler chickens. For many of the farmers who participate in the practice, they have little control over the manner in which the chickens are raised since usually the only components they themselves supply are the chicken houses. In 2000, The Delmarva Poultry Industry reported that there were, “...5,816 broiler houses with an annual production of 60 million birds on the Delmarva Peninsula,” an area that includes Maryland’s Eastern Shore (Paolisso & Maloney, 2000, p.212). Such large numbers of broiler chickens being produced generates a great deal of poultry litter, or waste. Since the contracting businesses will not dispose of the waste produced from their chickens, farmers use as much litter as possible to manure their fields of crops and pastures. However, the excessive amounts being currently produced raises questions as to how the surplus will be stored or disposed of. Poultry farmers attempt to give away, sell, or mound litter underneath specially constructed storage sheds. However, many farmers quickly run out of room and proceed to pile the litter outside of the sheds with little or no protection. Situations such as the one just described contribute to high levels of nutrient runoff, especially phosphorus, which has been linked with *Pfiesteria* outbreaks in intense animal agriculture areas such as the Pocomoke watershed (Paolisso, 1999, p. 54).

While nutrient runoff has played a significant role in creating conditions in waterbodies amicable to the toxic dinoflagellate, there are many cultural factors that also must be looked at when assessing the guilt of the farming community in the situation. Paolisso reports that contrary to public opinion at the time of the Pfiesteria outbreak, a great number of farmers on the Eastern Shore were extremely concerned about the environmental degradation (1999, p. 55). The problem as they see it is that they encounter complex agronomic and economic realities of contemporary farming that were mostly overlooked in the debate concerning farms and Pfiesteria. Due to the multiple variables that combine to determine the cost, yields, and market value of all crops, farmers must be careful in using new, complicated, expensive, or unproven techniques on the whole of their land (Paolisso, 1999, p. 56). It is not that the farmers do not wish to find a solution to the problem; it is that their existence is often tied to the land and must take into account all the impacts new practices may incur on the continuation of farming as a profitable way of life. Farmer environmentalism, say Paolisso and Maloney, is locally derived and based on local values, beliefs, and livelihood strategies (2000, p. 219).

To Eastern Shore farmers, their land is an extension of their home and therefore they must care for and manage it in such a way that reflects well on their position in the community. Paolisso and Maloney found three key themes in their study that underlie the farmers views on the environment: a sense of closeness to and dependence on the land, an economic and utilitarian view of nature, and a perception that nature can not be fully known or understood (2000, p. 214). Modern farm management is complex and many farmers have their own sense of environmental responsibility that should be taken

into consideration by state agencies in charge of the development and implementation of regulating policies. By merely passing strict regulatory laws, farmers are at the whim of a governing body that has changed its policies on environmentally friendly farming practices numerous times in past years. Many farmers have become unsure of which practices are truly the most economical and environmentally conscious and as such view new regulations warily.

Paolisso and Maloney have also developed the idea, based on aforementioned views on the environment and nature on the Eastern Shore, that *Pfiesteria* has become a symbol to different stakeholders in the area. *Pfiesteria* has become a symbol of incursion of state agencies and environmentalists into the farmers' lives, dictating in what manner they should farm but neglecting to listen to or appreciate that the farmers are also concerned about water pollution. For poultry farmers, especially, *Pfiesteria* also represents an unfortunate ecological event due to natural processes that cannot be fully understood by science because of the complexities of nature. *Pfiesteria* has also become a symbol for watermen who earn their living off the land and water. *Pfiesteria* is a threat to their livelihood and potentially their health, a threat partly exacerbated by farmers in the community (2001, p. 7).

The concerns over health implications expressed by the watermen are another important impact of *Pfiesteria* on the Eastern Shore community. While working on the Pocomoke estuary during 1996, waterman began to experience health problems. Symptoms appeared to increase significantly during the large outbreak of *Pfiesteria* that was identified in 1997 (Grattan et. al, 1998, p. 532). The dinoflagellate's toxin is released into the water but can also aerosol and become present in the air in the

immediate vicinity of affected waterbodies (Kempton & Falk, 2000, p. 274). The aerosol process means that a human in the area of a fish kill caused by *Pfiesteria* would be exposed to the toxin and could develop health problems as a consequence.

Three groups of humans exposed to the toxin that developed health problems identified by Kempton and Falk were: watermen working on boats over water during the outbreak, fishers who put their hands into the water or touched affected fish during the outbreak, and researchers in labs breathing from improperly ventilated tanks containing high concentration of *Pfiesteria* (Kempton and Falk, 2000, p. 274). No conclusive documentation on the health affects of consuming affected fish has been found, although the lesions can carry pathogenic microbes. Human health affects that have been found from coming into contact with the toxic include skin rashes, nausea, burning eyes, headaches, and memory disturbance of up to six months (Paolisso, 1999, p. 54). One of the most recognized health impacts is that of neurological disturbances.

Many watermen who came into contact with the toxin experienced loss of memory and confusion for a significant period of time after they had left the affected area. One man with neuropsychological symptoms could not remember where his destination was or why he was going there after he had already begun to drive his vehicle to the destination (Grattan et. al, p. 535). A study of people highly to moderately exposed to the Pocomoke River during the outbreak found more severe effects on those with chronic exposure to the water when toxin-producing *Pfiesteria* were present. The most consistent finding among exposed individuals was a deficit in new learning and selective or divided attention (Grattan et. al, 1998, p. 537).

Human health impacts caused by *Pfiesteria* have many ramifications. Watermen who have made their living off of the Pocomoke and other waterbodies located near the Eastern Shore may be more reluctant to continue their traditional livelihood or at least be more wary of the seafood that they can sell commercially. Health implications also affect the farmers of the Eastern Shore as it contributes to the negative outlook on farmers as polluters who are contributing to such a negative occurrence.

Increased public knowledge about such health impacts may have caused there to be more unwillingness to consume seafood products. In turn, the Eastern Shore waterman and the economy of the area in general were negatively affected. As news about the *Pfiesteria* outbreak continued to grow in late August and September of 1997, there was a steep and definite decline in the sales volume of seafood products associated with the Eastern Shore (Lipton, 1999). Although no definite findings had been reported concerning a link between consumption of seafood and negative health affects during the outbreak, this did not quell the concerns of the public. The uneasiness of consumers over the toxic *Pfiesteria* outbreak in the Chesapeake Bay watershed could be clearly seen in the drop of sales. During the outbreak many stores put out advertisements that they did not sell any Maryland seafood, not just seafood form the Eastern Shore, as seafood sales declined (Magnien, 2001, p. 847). By Lipton's calculations, a total of forty-three million dollars were lost in seafood sales because of the publics concern about seafood safety (Lipton, 1999). Those with the biggest losses were sellers who specialized in the distribution of Chesapeake Bay products. The fish and other seafood from the Chesapeake Bay was seen as more of a health threat since it was closer to the source of the *Pfiesteria* outbreak.

Recreational fishing in the area also suffered monetary losses due to the outbreak. Although many areas used by the recreational fishing industry were not on the Pocomoke or its tributaries, the perceived high risk of exposure to *Pfiesteria* kept many people away. Recreational fishing losses to charter boat captains and fishermen were only four million dollars. However, the amount is much more than the mere forty thousand dollars that would have been lost had local authorities simply shut down the areas impacted by *Pfiesteria* due to the fact that these areas were seldom used for recreation activities (1999).

The Eastern Shore of Maryland was impacted by the outbreak of the toxic dinoflagellate *Pfiesteria* in a number of ways. There were not only physical and environmental impacts concerning farmers and nutrient runoff that altered the ecology of the Pocomoke River and other Chesapeake Bay tributaries along the watershed; there were also human implications of the outbreak. *Pfiesteria* affected the human population of the Eastern Shore by impacting the culture, health, and economics of the area. Farmers and watermen who depend on the land and water for their livelihood were faced with an uncertain future. The farmers were quickly implicated, especially by the media, as polluters who allowed excess nutrients from poultry manure on their farms to run off into the waterways and contributing to the *Pfiesteria* outbreak when most farmers were greatly concerned about the environmental ramifications of the situation. Watermen were unsure how the toxic outbreak would affect their ability to make a profit from seafood sales and faced health problems from being exposed to affected waters. Health concerns related to the toxin released by *Pfiesteria* caused the public and many consumers to shy away from buying seafood taken from the Chesapeake Bay area, or sometimes from any

seafood at all. The result was an economic loss for the area in commercial fish sales and in the recreational fishing industry.

For many reasons, *Pfiesteria* is more than just a scientific microorganism that should be studied for its biological properties and physical affects. The outlook for the Eastern Shore and the community that lives there has been greatly altered by the impacts of *Pfiesteria*. Farmers must now face increased investigation into their farming techniques. While increased research is not a negative aspect in itself, it has made farmers feel as though they must defend their commitment to the land and its continued health as well as the health of the waterbodies affected by the runoff generated by their land. The continued study of practices used by farmers and watermen on the Eastern Shore has the potential to be beneficial for future policy development if a common language between the cultural and physical science aspects of *Pfiesteria* can be found.

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