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Fish Lesions, Pfiesteria and The Chesapeake Bay

Virginia Sea Grant Marine Advisory Program

Fish Lesions, *Pfiesteria* And The Chesapeake Bay

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Recent fish kills and closures in the Pocomoke River have increased public concern over *Pfiesteria piscicida*, a microorganism that has been linked to large fish kills in North Carolina. In response to concerns about an unusual number of fish with lesions reported in Chesapeake Bay, especially the Pocomoke River, a Virginia *Pfiesteria* Task Force was formed in May 1997. The Task Force includes members of the Virginia Marine Resources Commission (VMRC), the Virginia Department of Health (VDH), the Virginia Department of Environmental Quality (DEQ), and research scientists from Virginia Institute of Marine Science (VIMS), and Old Dominion University (ODU). The Task Force has developed an information network that enables members to respond quickly and efficiently to events.

What causes lesions (open sores) on fish?

There are many possible causes for fish lesions including physical injury in nets or traps, bites by other fish or birds, toxic chemicals, and infectious disease agents such as viruses, bacteria and fungi. On the basis of laboratory experiments, we now have to add toxins released by *Pfiesteria* to the list of possible causes. Currently, it is very difficult to determine the original cause of a lesion unless an obvious parasite is present because basic knowledge of the physiologic and environmental factors related to lesions in fish is insufficient.

Open sores that expose the underlying musculature are the most difficult kind of lesion to assess. The skin and mucus of a fish are effective barriers against infection by bacteria, which are always present in Chesapeake Bay waters. However, that barrier can be broken by a variety of causes including injury, general stress or toxic chemicals (including *Pfiesteria* toxins). When the skin/mucus barrier is broken, the area is usually rapidly colonized by bacteria which further erode the tissue and produce an open lesion or sore that may penetrate deep into the musculature. In such cases, the cause of the original break in the skin/mucus barrier that led to the lesion is difficult to determine with our present state of knowledge.

Have there been unusually high numbers of fish lesions during 1997?

No, not in most areas of Chesapeake Bay. Some fish lesions occur every summer in Chesapeake Bay and based on information from VMRC, DEQ and VIMS and also from agencies in Maryland, the incidence of lesions on Chesapeake Bay fish during 1997 is not unusually high and there is no indication that fish populations are facing serious problems.

The Pocomoke River, located on the Eastern Shore near the Virginia-Maryland border, may be an exception. Commercial fishermen have reported what they consider to be unusually high numbers of fish lesions in the Pocomoke River and there were low- to moderate-level fish kills in the river during August. These lesions and kills have been linked to the toxic dinoflagellate *Pfiesteria piscicida*, but the link is as yet circumstantial.

Have fish kills occurred in Chesapeake Bay in the past?

Small- to moderate-scale fish kills, usually of small menhaden, occur occasionally in tidal creeks during the summer months. These kills are usually caused by low oxygen

content of the water, but other possible causes, now including *Pfiesteria*, are routinely investigated.

Who should I call if I see a fish kill or see fish with lesions?

A few fish here and there with lesions, or even a few washed up dead on the beach, is not an uncommon occurrence and there is little cause for concern. However, if large numbers of fish with lesions or dead fish are observed, the appropriate agencies should be notified. The Virginia Department of Environmental Quality (DEQ) has responsibility for investigating fish kills.

What is *Pfiesteria* and is it related to red tides?

Contrary to some recent press reports, *Pfiesteria piscicida* is not a virus or bacterium and it is not an infectious agent; fish or other organisms cannot become infected with *Pfiesteria*. *Pfiesteria piscicida* is a dinoflagellate, a microscopic, free-floating, single-celled organism with two flagella for locomotion. Most dinoflagellates are plants (called algae or phytoplankton) that gain energy from photosynthesis. However, many species of dinoflagellates, including *Pfiesteria*, do not photosynthesize, but behave like animals and consume algae or bits of organic matter. Normally, *Pfiesteria* feeds on algae cells. However, under certain circumstances that are not understood, and only in the presence of live fish, *Pfiesteria* can release a toxin that can cause sloughing of the surface layer of fish skin and, in high concentrations, can kill fish. *Pfiesteria* has been implicated in fish kills in North Carolina and in the Pocomoke River near the Virginia/Maryland border on the Eastern Shore.

There are two reasons that the public may connect *Pfiesteria* and "red tides." *Pfiesteria* is a dinoflagellate and red tides are typically, but not always, caused by dinoflagellates. *Pfiesteria* is known to be toxic to fish and red tides are often, but not always, toxic to marine life. Despite these similarities, there are important distinctions to be made between *Pfiesteria* and red tides, especially for the Chesapeake Bay region. *Pfiesteria* is reported to kill fish when it occurs at low concentrations in the water, typically a few hundred cells per milliliter (.00026 gallons) of water. This is not a sufficient concentration of cells to discolor the water and *Pfiesteria* has never been reported to cause discolored water.

Red tides (also called red water or mahogany water) are typically caused by the dense accumulation, typically thousands of cells per milliliter of water, of dinoflagellates near the surface. Red tides are common occurrences in the Chesapeake Bay and its tributaries. They can occur at any time of year but usually are most common during July and August. Unlike other coastal regions of the United States where red tides result in fish death and bans on eating shellfish, red tides in the Chesapeake Bay to date have not been toxic to marine life. This lack of toxicity is because the species of dinoflagellates causing red tides in Chesapeake Bay are not toxic species. Red tides are typically categorized as a type of Harmful Algal Bloom (HAB), whether they are harmful to aquatic life or not. There is increasing interest in HABs worldwide because of the perception that they are becoming much more numerous, are often toxic to marine life, and are likely caused by man's influence on coastal areas. Because of their lack of toxicity to date, there has been less urgency to study red tides in the Chesapeake Bay and it is not clear what causes them and whether they are becoming more numerous.

Does *Pfiesteria* occur in Virginia?

Pfiesteria is known to occur from the Gulf of Mexico along the east coast as far north as Delaware Bay. It has been reported in Virginia waters near the mouth of the Pocomoke River and it is known to occur in Maryland. *Pfiesteria* is probably an ubiquitous organism that occurs all along the east coast in low numbers.

Is there a relationships between *Pfiesteria* and environmental degradation?

Popular press reports of *Pfiesteria* and its possible effect on fish often suggest that nutrient enrichment of estuaries and coastal waters from a variety of land-derived sources is a principal cause of *Pfiesteria* proliferation and activity. Some scientific literature suggests a similar relationship. Manure from hog and chicken production facilities is often identified as a source of nutrients. The association between *Pfiesteria* and nutrient enrichment is also fostered by the tendency to associate *Pfiesteria* with algal blooms, which are well documented to result, in part, from nutrient enrichment of natural waters. However, as discussed above, *Pfiesteria* is not an algae and does not make its own food by photosynthesis and does not require dissolved nitrogen and phosphorous (two typical nutrients) in the water for its nutrition. *Pfiesteria* eats other microscopic plants and animals. Because it is an animal and not a plant it is less likely to respond directly to nutrient enrichment. To the extent that its preferred food is microscopic algae, one might expect *Pfiesteria* to be more abundant where its preferred food is more abundant. Thus, it might be indirectly linked to nutrient enrichment through its food supply.

In general, the Chesapeake Bay and its tributaries are not as enriched with nutrients as the Pamlico Sound and its tributaries in North Carolina, yet *Pfiesteria* has been reported from various locations in the Chesapeake Bay and has been linked to fish kills and human health problems in the Pocomoke River. However, based on common indices of nutrient enrichment used for the Chesapeake Bay, the Pocomoke River is not considered to be highly enriched. Other, more enriched areas of the Bay have not experienced fish kills or fish with lesions. The carefully controlled scientific experiments which identify nutrient enrichment as a stimulus to *Pfiesteria* are few and others are currently being conducted. Until more results are available it is not possible to say with confidence why *Pfiesteria* occurs where it does and why it becomes toxic when and where it does.

Can Chesapeake Bay expect large-scale fish kills similar to North Carolina?

When fish with lesions were first observed in the Pocomoke River there was doubt about the possible role of *Pfiesteria* as a cause because of the lack of large numbers of dead fish on the surface. In North Carolina, where *Pfiesteria* has been reported to be the cause of fish kills, there are reports of large numbers of dead fish, often hundreds of thousands to millions, during fish kills. Recent fish kills in the Pocomoke River, attributable to *Pfiesteria*, report thousands to perhaps tens of thousands of dead fish, much lower numbers than observed in North Carolina.

One possible explanation for the fewer numbers of dead fish in the Chesapeake Bay region as a result of *Pfiesteria* may be differences in hydrography between these two regions. The Pamlico Sound and Neuse River estuary in North Carolina are very shallow, poorly flushed estuaries with weak tidal currents. By contrast, the Chesapeake Bay and its tributaries are typically deeper, better flushed and have stronger tidal currents. If *Pfiesteria* in the sediments are detecting fish in the overlying water column by means of chemical cues from the fish, as some scientists believe, and if fish death is caused by a chemical toxin produced by *Pfiesteria*, then it is possible that the greater the dispersion of these chemical cues and toxins by water currents and circulation, the fewer fish will be detected and killed. Also, in deeper water, fish may be less concentrated.

There is much yet to be learned about *Pfiesteria* and its role in fish lesions and death, but this is one possible reason that *Pfiesteria* reported in the Chesapeake Bay region may not be as much as a problem as reported for North Carolina.

Is it safe to eat Virginia seafood?

YES, Chesapeake Bay seafood is safe. Consumers should use common sense and avoid dead fish or fish with sores, but otherwise there is no reason to avoid eating Virginia seafood. There have been no reports of adverse effects on human health from eating shellfish (crabs, oysters, etc.) harvested in the vicinity of fish kills.

Does *Pfiesteria* affect humans?

A variety of symptoms have been reported by commercial watermen and other citizens in North Carolina, Maryland and Virginia and by researchers who cultured *Pfiesteria* in the laboratory. Symptoms, including sores, fatigue and short-term memory loss, have only been associated with laboratory exposure, or with large-scale fish kills in North Carolina and with fish kills in the Pocomoke River in Maryland and Virginia. Portions of the Pocomoke River were closed periodically during August because of possible human health concerns. Establishing a definite link between generalized symptoms and *Pfiesteria* is difficult, but health officials are studying the situation carefully. Your local health department has up to date information.

Toll-free Hotline 1-888-238-6154
Updates are also located at the VIMS web site:
http//www.vims.edu

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