



# VIRGINIA

# EPIDEMIOLOGY BULLETIN

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## *The Public Health Implications of Pfiesteria*

### **Introduction**

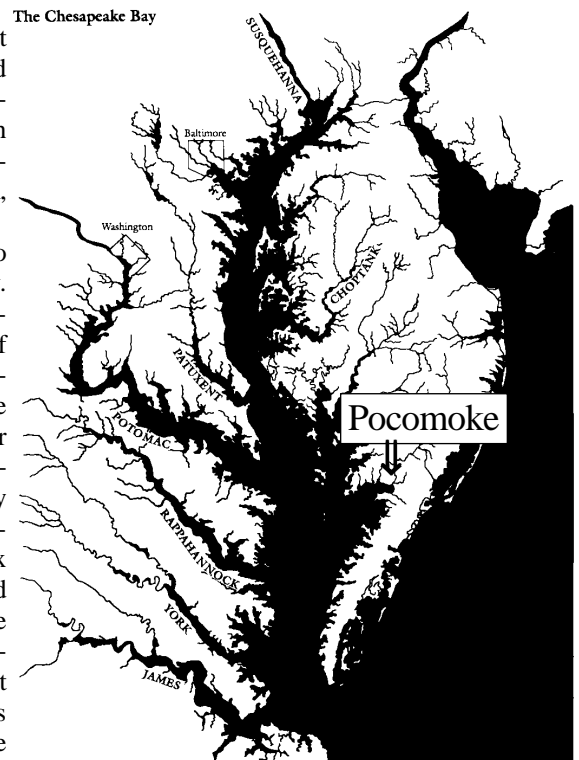
*Pfiesteria piscicida* is one of a number of species of microscopic, single celled dinoflagellates. It was first identified in 1988 at a North Carolina State University laboratory,<sup>1</sup> although it has probably existed in the environment for thousands of years. It has a complex life cycle that includes 24 life stages. In its dormant stage, it is a sediment-dwelling cyst. Unidentified environmental and biological cues (specific nutrient conditions and/or fish excretions have been suggested as possible cues) stimulate the cysts to transform into toxin-producing amoebae and then into an active, free-swimming form. The toxin(s) affects the nervous system and skin of the fish. Depending on the toxin concentration level, affected fish may display a spectrum of disease outcomes ranging from skin lesions to a massive fish kill.<sup>1</sup> Atlantic menhaden (*Brevoortia tyrannus* Latrobe) appear to be the most susceptible fish species.

The *Pfiesteria* toxin(s) is believed to remain stable for <24 hours and then to disinte-

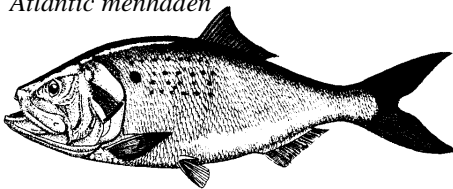
grate. Due to this instability, it is not believed to concentrate in the fish food chain. It typically disappears from affected waters within 21 hours of a fish kill.<sup>1</sup> *Pfiesteria* organisms do not appear to be transmitted from fish to fish, fish to person, or person to person.

Many dinoflagellates are similar to *P. piscicida* under light microscopy. Specific identification requires scanning electron microscopy (SEM) of cells that have had membranes removed so that the cell plates can be characterized. An unknown number of these similar organisms may produce biotoxins, cause fish morbidity and mortality, or cause illness in humans. The term *Pfiesteria* Complex Organism (PCO) has been adopted since many of these organisms have not been identified to genus and species and confirmation by SEM is not always possible. To date, ten PCOs have been recognized, but few have been named.

Hard data are lacking on the significance of fish with skin lesions; skin ulcers are non-specific and could be caused by bacteria, viruses, fungi, parasites, chemical toxicants or physical injury. Unfortunately, there is no laboratory test to confirm PCO disease in fish. In the laboratory setting, the toxin is known to cause skin erosion in fish, although specific lesion morphology cannot be attributed solely to PCOs because bacteria rapidly invade eroded areas. Finding fish with ulcerative skin lesions is not a new phenomenon. Since the 1980s, Atlantic menhaden have been observed with ulcerative skin lesions in the mid- and south Atlantic coastal estuaries\* and bays from Delaware to Florida. In Virginia, as early as 1984, routine monitoring by the



Atlantic menhaden



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Virginia Institute of Marine Science (VIMS) has annually identified medhaden with ulcers in the Rappahannock River during the fall. Prevalence varies from year to year. It is possible these lesions have been caused by PCOs, but that cannot be determined at this time.

Until recently, the only documented human health impact due to PCO exposure has occurred in a laboratory setting.<sup>1</sup> Laboratory personnel, presumably exposed to aerosol of active culture water, complained of acute symptoms such as headache, abdominal cramps or pain, nausea, vomiting, eye irritation, respiratory distress, skin lesions, narcosis, altered mental state, and short-term

\*Areas at the mouth of a river where fresh river water mixes with salty sea water.



memory loss lasting 1-8 weeks. It was noted that the laboratory ventilation system was working incorrectly, such that the laboratory environment was potentially exposed to excessive toxin concentration levels. Physical and neurologic examinations were normal by 11 weeks, but some persons report residual symptoms 1-6 years postexposure.

### North Carolina

A descriptive epidemiologic study was conducted between April and October 1995 by the North Carolina Department of Environment, Health and Natural Resources (personal communication). Workers who were occupationally exposed to three PCO-related fish kills in 1995 were interviewed to document any acute health effects. Fish kills on July 27, August 8 and September 19 were compared. Only the September 19th fish kill was found to be associated with reported health complaints, including self-reported cognitive impairment and a variety of other symptoms. The investigators concluded that the inconsistency in symptom patterns related to the three fish kills could be due to differences in toxin exposure, presence of other causative agents, or biased reporting of symptomatology.

A study reported in March 1997 by researchers from East Carolina University, compared 252 crabbers who worked in a PCO-affected area with two groups: 114 crabbers who worked in an unaffected area and 125

*The Virginia Epidemiology Bulletin for 1997 is now on the World Wide Web. You can read or print copies of any 1997 issue at [www.vdh.state.va.us/epi/bulletin.htm](http://www.vdh.state.va.us/epi/bulletin.htm)*

non-fishing residents of the communities of the crabbers who worked in the PCO-affected area (personal communication). The authors concluded that the two groups of crabbers and the community residents reported similar levels of illness and injury. One exception was skin disorders, prevalent among both groups of crabbers but not among community residents; however, this difference could be explained as an occupational hazard among crabbers.

### Maryland

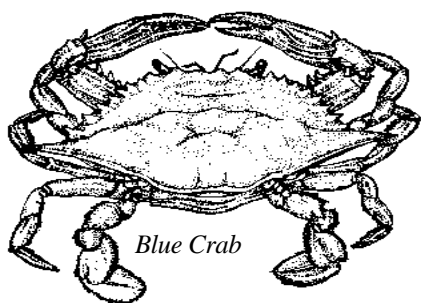
During the fall of 1996 and the spring of 1997, a group of 13 occupationally exposed individuals were identified with the following complaints: fatigue, headache, respiratory irritation, diarrhea, weight loss, skin irritation or rash, and memory problems. The Maryland Department of Health and Mental Hygiene assembled a medical team to examine the group (personal communication). The medical team reported negative findings in the physical examination, baseline blood chemistry tests, pulmonary function tests and immunologic function tests. Administration of selected neuropsychological test batteries revealed that 87% of a "high exposure" group (n=8) had problems with verbal learning and memory, as well as inability to concentrate, compared to 0% of a control group (n=8).

### CDC

As a result of these findings and because of the public health implications of possible human health effects related to PCOs, the Centers for Disease Control and Prevention (CDC) convened a meeting with Atlantic coast State Health Departments in September 1997 to establish a standardized suspect-case definition to be used for PCO-associated illness in humans.<sup>2</sup> It should be noted that this case definition was designed to identify persons who should be examined to determine what, if any, health effects are related to PCO exposure and should not be used as a clinical diagnostic tool. The CDC suspect-case definition requires affected persons to have had exposure to estuarine waters with a history of either fish kills or fish lesions associated with PCO toxicity. Persons meeting the suspect-case definition must also have either memory loss or confusion or skin burning upon direct contact with water. In the absence of these signs and symptoms, the criteria can be met if a combination of three of the following is documented: headache, skin rash, upper respiratory irritation, muscle cramps, eye irritation or gastrointestinal symptoms such as nausea, vomiting, diarrhea, or abdominal cramps.

### Virginia

On August 26, 1997, a fish kill occurred in Virginia's portion of the Pocomoke River on the Eastern Shore where approximately 2,000 dead menhaden were observed. In addition to this fish kill, Virginia identified medhaden with lesions compatible with *Pfiesteria* toxin exposure in the Rappahannock and Great Wicomico rivers in September. Water and sediment samples from all three rivers revealed PCOs, but no toxic activity developed when these organisms were grown in the laboratory. Specific identification of the organisms is still pending.



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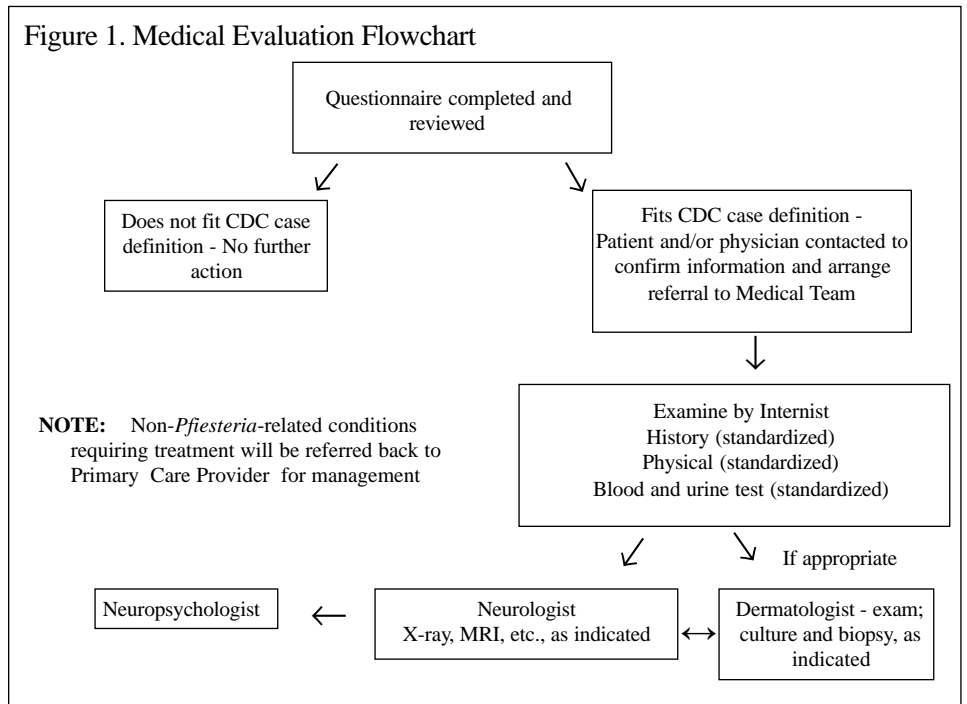
**Pfiesteria Hotline  
Number  
888/238-6154**

On September 18, the Virginia Department of Health began operating a toll-free telephone *Pfiesteria* hotline. As of December 31, 157 calls had been received. Of these, 114 were general education questions, 34 were about illnesses unrelated to *Pfiesteria*, and nine met the CDC suspect-case definition.

Of the nine who met the case definition, five have accepted referral for medical evaluation. The medical evaluation (Figure 1) is standardized and includes two parts. Part one includes a history, physical examination, baseline laboratory testing, and neurological evaluation. Part two includes Magnetic Resonance Imaging (MRI) and neuropsychological evaluation. Four persons have completed both parts of the examination, except for one who did not have the MRI. Another person has completed part one of the examination and may return next year for the remainder. The other four persons were either unreachable or were feeling better and not interested in being examined.

Although the four extensively examined persons had a number of medical complaints, nothing of significance that appeared to be related to *Pfiesteria* was identified during the first part of the examinations. During the second part of the examinations, two persons showed abnormalities in brain function for which a cause could not be determined. Both of these persons had been exposed to the Potomac River. The abnormalities were not severe and would not have been identified

Figure 1. Medical Evaluation Flowchart



without using neuropsychological testing for evaluation. These persons will be followed with further testing. With only two of four persons showing unexplained abnormalities, it is difficult to draw any conclusions as to the cause.

Virginia physicians examining patients who meet the CDC suspect-case definition are asked to report them to the Virginia Department of Health hotline or to their local health department.

**Discussion**

Much is still unknown about PCOs. Rapid methods are needed to identify the organism and toxin. Identification is difficult because

of the many different organisms and life stages and their varied requirements for growth. As we learn more about the biology of these organisms, the environmental and biological cues that trigger the cysts to bloom into toxic stages, and the related possible human health effects, we will be in a better position to provide effective control measures and recommendations.

Cause and effect can best be determined by studying populations at risk, such as watermen and other occupational or recreational groups, compared with controls over time. Exposure information, medical evaluations and water monitoring data can all be coordinated to look for an association.

In 1998, Virginia will collaborate with Delaware, Maryland, North Carolina, Florida, and CDC to conduct epidemiologic studies on populations of persons who have considerable contact with marine waters. Researchers from the five states and CDC have agreed to use a standard protocol for such studies and will be meeting in early January to establish the exact parameters of the studies.

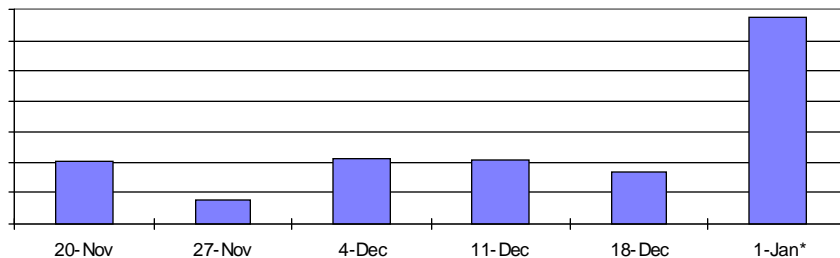
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Submitted by John V. Rullan, M.D., M.P.H., Deputy Director, Office of Epidemiology

**Flu Corner**

Influenza activity in Virginia has been characterized as regional, effective January 1, 1998. Laboratory-confirmed cases of influenza type A have been reported from the northwest and southwest health planning regions. The graph below represents the trend in influenza-like illness cases reported by sentinel physicians throughout the state.



\*Two week combined period.

**Cases of Selected Notifiable Diseases Reported in Virginia\***

Disease	Total Cases Reported, November 1997						Total Cases Reported Statewide, January through November		
	State	Regions					This Year	Last Year	5 Yr Avg
		NW	N	SW	C	E			
AIDS	106	4	18	7	21	56	1047	1104	1106
Campylobacteriosis	57	10	18	7	15	7	577	729	657
Giardiasis	48	4	23	2	7	12	415	335	315
Gonorrhea	814	56	94	94	96	474	7935	8428	10823
Hepatitis A	17	3	8	3	1	2	212	173	164
Hepatitis B	11	0	1	2	4	4	117	130	132
Hepatitis NANB	0	0	0	0	0	0	24	16	28
HIV Infection	79	4	25	2	28	20	880	902	1096
Influenza	1	0	0	0	0	1	455	412	693
Legionellosis	5	1	0	1	0	3	26	37	20
Lyme Disease	8	2	4	0	1	1	61	49	82
Measles	0	0	0	0	0	0	1	3	5
Meningitis, Aseptic	40	7	8	10	0	15	232	210	366
Meningitis, Bacterial†	5	4	1	0	0	0	80	66	90
Meningococcal Infections	10	0	1	4	3	2	58	56	56
Mumps	8	1	2	1	2	2	18	16	34
Pertussis	10	5	3	0	2	0	52	98	48
Rabies in Animals	72	14	30	12	13	3	637	570	416
Rocky Mountain Spotted Fever	3	1	0	1	0	1	22	53	28
Rubella	0	0	0	0	0	0	1	2	0
Salmonellosis	103	22	28	8	21	24	989	1115	1018
Shigellosis	26	4	15	2	1	4	402	666	495
Syphilis, Early‡	44	1	3	5	17	18	581	753	1105
Tuberculosis	12	0	2	2	1	7	305	293	321

*Localities Reporting Animal Rabies This Month:* Alexandria 3 raccoons; Amherst 2 raccoons; Appomattox 1 raccoon; Arlington 2 raccoons; Augusta 1 raccoon; Bath 1 skunk; Bedford 2 skunks; Buckingham 1 raccoon; Campbell 1 raccoon; Caroline 1 raccoon; Chesterfield 1 cat, 3 raccoons; Clarke 1 raccoon; Dinwiddie 1 raccoon; Fairfax 3 bats, 9 raccoons, 3 skunks; Fauquier 1 raccoon; Floyd 1 raccoon; Halifax 1 skunk; Hanover 1 groundhog, 3 raccoons, 1 skunk; Henrico 1 raccoon; James City 1 skunk; Loudoun 4 raccoons; Louisa 1 raccoon; Nelson 2 raccoons, 2 skunks; Orange 1 raccoon; Patrick 1 fox; Pittsylvania 2 raccoons; Prince William 2 bats, 1 fox, 3 raccoons; Spotsylvania 1 raccoon; Stafford 1 raccoon; Tazewell 1 skunk; Virginia Beach 2 raccoons; Warren 1 raccoon; Wythe 1 skunk.

*Occupational Illnesses:* Arsenic Exposure 1; Asbestosis 30; Carpal Tunnel Syndrome 48; DeQuervain's Syndrome 1; Hearing Loss 15; Lead Poisoning 2; Pneumoconiosis 5.

\*Data for 1997 are provisional. †Other than meningococcal. ‡Includes primary, secondary, and early latent.

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