HETA 97-0327-2665
U.S. Fish and Wildlife Service
Warm Springs Regional Fisheries Center
Warm Springs, Georgia

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PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

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ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by Thomas Hales, M.D., M.P.H., Sally Brown, B.S.N., M.P.H., Max Kiefer, C.I.H., and Janie Gittleman, Ph.D., of the Hazard Evaluations and Technical Assistance Branch, Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS). Desktop publishing was performed by Patricia C. McGraw.

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Health Hazard Evaluation Report 97-0327-2665
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November 1997

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SUMMARY

In September 1997, the National Institute for Occupational Safety and Health (NIOSH) received a management request to conduct a health hazard evaluation (HHE) at the U.S. Fish and Wildlife Service (USFWS) Warm Springs Regional Fisheries Center in Warm Springs, Georgia. The request asked NIOSH to address two issues: (1) whether Warm Springs USFWS employees were potentially exposed to the dinoflagellate *Pfiesteria piscicida* during work activities; and (2) if employees did have the potential for *P. piscicida* exposure, what precautionary measures (work practices and/or personal protective gear) should be used. In October 1997, NIOSH investigators conducted a site-visit at the Warm Springs facility. The site-visit consisted of an opening conference, review of facility operations, review of satellite operations (e.g. hatcheries), a walk-through inspection, and informal employee interviews. Following the facility inspection, a closing conference was held with Warm Springs USFWS representatives. Finally, subsequent to the site visit, regional USFWS safety and health personnel were contacted regarding current policies for USFWS employees exposed to fish kill waters.

At the present time, employees at the Warm Springs Regional Fishery Center are unlikely to come into contact with *Pfiesteria piscicida* contaminated water or affected/infected fish. In addition, workers are not reporting symptoms suggestive of *P. piscicida* exposure. Therefore, we do not recommend changes to current work practices or polices for personal protection equipment at the Warms Springs facility. However, if USFWS employees begin to conduct studies with the *P. piscicida* organism, or participate in investigations of fish kills, appropriate precautions should be developed. These recommendations, and others, are contained in this report.

KEYWORDS: SIC Code 0921 (Fish Hatcheries and Preserves), *Pfiesteria*, *Pfiesteria piscicida*, fish toxin, neurobehavioral effects, memory loss, fish biologists.

INTRODUCTION

On September 24, 1997, the National Institute for Occupational Safety and Health (NIOSH) received a management request to conduct a health hazard evaluation (HHE) at the U.S. Fish and Wildlife Service (USFWS) Warm Springs Regional Fisheries Center in Warm Springs, Georgia. The request asked NIOSH to address two issues: (1) whether Warm Springs USFWS employees were potentially exposed to the dinoflagellate *Pfiesteria piscicida* during work activities; and (2) if employees did have the potential for *P. piscicida* exposure, what precautionary measures (work practices and/or personal protective gear) should be used.

On October 1, 1997, NIOSH investigators conducted a site-visit at the Warm Springs facility to review USFWS operations and evaluate the potential for employee exposure to *P. piscicida*. The site-visit consisted of an opening conference, review of facility operations, review of satellite operations (e.g. hatcheries), a walk-through inspection, and informal employee interviews. Following the facility inspection, a closing conference was held with Warm Springs USFWS representatives. Finally, subsequent to the site-visit, regional USFWS safety and health personnel were contacted regarding current policies for USFWS employees exposed to fish kill waters.

BACKGROUND

Pfiesteria Piscicida

P. piscicida and morphologically-related organisms (MROs) are dinoflagellates implicated in recent estuarine fish kills on the U.S. Eastern seaboard. These organisms appear similar under light microscopy and require scanning electron microscopy for definitive identification. *P. piscicida* is indigenous in estuaries along the Eastern seaboard and exists in a benign cyst-like state. Under specific environmental conditions, cyst-like *P. piscicida* are theorized to evolve into flagellated and amoeboid stages. These specific environmental conditions are thought to be increased water temperature and salinity, slowing estuarine currents, increased phosphorous and nitrogen contaminants, decreased oxygen, and increased presence of large schools of oily fish producing excretions/secretions. [Glasgow, et al. 1995] It is generally agreed that at least two toxins are secreted during the flagellated and amoeboid stages. [NIEHS 1997] These toxins are presumably responsible for fish kills, and efforts are underway to identify, isolate, and characterize these toxins. Affected fish, most notably Atlantic menhaden, have characteristic ulcerative lesions in the caudal/anal area. The specificity of this lesion for *P. piscicida* infection, or *P. piscicida* toxins, are unclear.

P. piscicida has been reported to cause health effects among laboratory workers working directly with the organism. [Glasgow, et al. 1995] During the summer of 1997, individuals with direct contact with water associated with *P. piscicida* fish kills reported some of the following symptoms: memory loss, confusion, skin burning, headaches, skin rashes, upper respiratory irritation, eye irritation, muscle cramps, nausea, vomiting, diarrhea, and abdominal cramps. [Maryland Medical Team, 1997] Other than neurocognitive function testing, efforts to document objective evidence of disease (physical examinations, blood chemistries, blood cell counts, blood immunologic studies, urinalysis, pulmonary function tests, skin biopsies) among these individuals have been unsuccessful. [Maryland Medical Team, 1997]

On September 29-30, 1997, NIOSH personnel attended a 2-day workshop on the Public Health Response to *Pfiesteria* hosted by the Centers for Disease Control and Prevention (CDC). State health department representatives from the Atlantic coast, and other federal agencies participated. The workshop addressed reported human health effects, developed a preliminary case definition, and proposed surveillance and future strategic investigative research efforts. A summary of the workshop is included as Attachment 1.

Warm Springs USFWS Facility

The Warm Springs Regional Fishery Center was established in 1899. The Center employs 12 USFWS workers, including fish biologists, hatchery managers, and administrative personnel. Three programs are administered from the Regional Fishery: Fish Hatchery, Fish Health Laboratory, and Fish Technology Center. The primary mission of the Fish Hatchery is to propagate and replenish the endangered short-nosed sturgeon. The primary mission of the Fish Health Laboratory is to provide state-of-the-art fish disease diagnostic and fish health certification services to a variety of fish hatcheries (Federal, State, and private). The primary function of the Fish Technology Center is to provide technical expertise and support to Regional fisheries and the private aquaculture industry, in addition to improving fish culturing techniques. The Regional Fishery Center also supports the Wild Fish Health Survey, an effort initiated in 1996 to determine the distribution of fish pathogens in the wild.

FINDINGS

Fish Hatchery

The water supply for the Warm Springs Fish Hatchery is obtained from a well source. Since *P. piscicida* is not known to contaminate wells or inland lakes/waters, employees working in this area are unlikely to have exposure to *P. piscicida*.

Three USFWS personnel work at the Bear Bluff, South Carolina, hatchery. Brackish waters (approximately 15-25% salinity) are piped into 400-gallon propagation tanks from a nearby estuary. Hatchery employees could be exposed to *P. piscicida* if these intake waters become contaminated with *P. piscicida*.

Fish Health Laboratory

Approximately 5-10 samples are logged in each month by the two fish biologists working in this program. The fish biologists conduct both visual and microbiological examinations. Major organ systems are examined and cultured for parasites, bacteria, and viral organisms. Disposable protective gloves (nitrile) are available but not routinely used. Housekeeping in the laboratory was good. Aisles were clear, and equipment and supplies were properly maintained, except in the chemical storage area where formaldehyde and hydrochloric acid were not properly separated. Safety procedures had been developed for specific laboratory activities.

According to USFWS personnel, most fish received are fresh water varieties, and their disease status is usually readily identified upon initial inspection. The log sheets did not suggest that fish with lesions characteristic of *P. piscicida* were received, nor were specimens captured from waters known to have *P. piscicida* fish kills. Based on this information, it is unlikely that fish biologists conducting the examinations have been exposed to *P. psicicida*.

Fish Technology Center

Based on interviews with USFWS employees, little opportunity exists for these employees to come into contact with *P. piscicida* contaminated water or infected fish.

Wild Fish Health Survey

This survey, a recent initiative of the USFWS, entails examination of primarily healthy fish populations to determine the distribution of fish pathogens. Inspecting and sampling from fish kills is not a component of this survey. USFWS employees participating in the survey may be asked, however, to assist state personnel during the clean-up and sampling of fish kills. If that particular fish kill was due to *P. piscicida*, USFWS employees would be at risk for exposure.

Employee Interview

Informal employee interviews were conducted by NIOSH representatives in each program administered from the Warm Springs Regional Fishery Center. No employees reported symptoms consistent with *P. piscicida* (Attachment 1).

Current FWS Policy

In October 1997, telephone conversations were held with Regions IV and V USFWS safety and health personnel to discuss activities for this potential occupational health problem. In May 1997, Region V developed and distributed an employee safety and health information notice. This notice described the current knowledge about the *P. piscicida* organism and provided resource names and telephone numbers. Specific safety precautions, such as personal protective equipment or work practices, have not been developed for USFWS personnel encountering fish kills.

Since little is known about the human health implications of exposure to this organism or its toxins, there is considerable Federal and State research underway on this issue. Some of the Federal agencies currently involved include the National Institute for Environmental Health Sciences (NIEHS), which is working to isolate and characterize *P. piscicida* toxins and their potential danger to human health; the Centers for Disease Control and Prevention (CDC), National Center for Environmental Health (NCEH) which is developing multi-state epidemiologic studies to determine possible health effects associated with *P. piscicida*, and is also conducting *P. piscicida* toxin research; the Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA) are working to coordinate activities to help mid-Atlantic states respond to *P. piscicida* outbreaks; and the Food and Drug Administration (FDA) is investigating *P. piscicida* in commercially distributed seafood. USFWS safety and health personnel should keep apprised of these developments and update their policies and recommendation for field personnel accordingly.

CONCLUSIONS AND RECOMMENDATIONS

1. At the present time, employees at the Warm Springs Regional Fishery Center are unlikely to come into contact with *P. piscicida*-contaminated water or affected/infected fish.

2. At the present time, USFWS employees at the Warm Springs Regional Fishery Center are not experiencing symptoms suggestive of *P. piscicida* exposure.

3. Since little is known about the potential of human health effects from *Pfiesteria*, its transmission route, or its exposure dose, specific recommendations cannot be based on established criteria. Therefore, conservative (erring on the side of safety) recommendations should be followed. If the intake waters for the Bear Bluff hatchery have:

a) fish kills associated with *P. piscicida*, or
b) fish with lesions characteristic of *P. piscicida*, or
c) hatchery fish with lesions characteristic of *P. piscicida*, [CDC 1997]

the intake valves should be closed. If this is not possible, hatchery employees should use personal protective equipment. The Maryland Department of Health and Mental Hygiene has developed guidelines for various situations (Attachment 2). These preliminary guidelines should be followed until more information becomes available. Fish suspected of having lesions consistent with *P. piscicida* should be sent to laboratories capable of determining the presence of *Pfiesteria*. For a list of laboratories capable of this type of analysis, contact: Lexie Kreckman, Georgia Department of Human Resources, Parasitology Laboratory, 1749 Clairmont Road, N.E., Decatur, Georgia 30033-4050, telephone (404) 327-7961.

4. The use of the disposable nitrile gloves should be used during the examination of fish with an

unknown disease.

5. If fish biologists begin to examine:
   a) fish associated with *P. piscicida* fish kills, or
   b) fish with lesions characteristic of *P. piscicida*,

the personal protective equipment recommended in Attachment 2 should be used.

6. Since the reported symptoms are not specific for *P. piscicida*, employees experiencing the symptoms listed in Attachment A should be evaluated by their primary care physician. If either the employee or the physician is concerned about a relationship to *P. piscicida* exposure, the Georgia Department of Public Health should be contacted. The contact person is: Lexie Kreckman, Georgia Department of Human Resources, Parasitology Laboratory, 1749 Clairmont Road, N.E., Decatur, Georgia 30033-4050, telephone (404)327-7961.

7. Ensure proper segregation of incompatible chemicals in the Fish Health Laboratory (e.g. formaldehyde and hydrochloric acid).

8. Prior to the summer of 1998, the Region V USFWS health and safety office should update their employee safety and health information notice on *Pfiesteria*. This notice should update employees regarding a) the potential for USFWS employees exposure to *P. piscicida*, b) evidence linking human health effects to *P. piscicida*, c) contact names and numbers to report possible exposures and symptoms thought to be related to *P. pisicicida* exposure, and d) current precautionary measures.

9. Region IV and the Warm Springs Regional Fishery Center are considering submitting three proposals to study the *Pfiesteria piscicida* organism. If these studies are undertaken, specific health and safety precautions would need to be developed for the participating employees.

REFERENCES

CDC. Results of the public health response to *Pfiesteria* workshop - Atlanta, Georgia, September 29-30, 1997. MMWR;46:951-952.

Glasgow HB, Burkholder JM, Schmechel DE, Tester, Rublee PA. Insidious Effects of a Toxic Estuarine Dinoflagellate on Fish Survival and Human Health. *J Toxicol Environ Health* 1995;46 (4):501-522.

Maryland Medical Team. Medical evaluation of persons with exposure to water containing *Pfiesteria* or *Pfiesteria*-like dinoflagellates. Interim Report. September 17, 1997. Maryland Department of Health and Mental Hygiene, Baltimore, MD.

NIEHS.Workshop on Hazardous Marine/Freshwater Microbes and Toxins. Book of Abstracts. August 26-27, 1997. National Institute for Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC 27709

ATTACHMENT 1

MMWR 1997;Vol. 46 / No. 40:951

Notice to Readers

Results of The Public Health Response to *Pfiesteria* Workshop — Atlanta, Georgia, September 29–30, 1997

On September 29–30, 1997, CDC sponsored a workshop to coordinate a multistate response to public health issues about *Pfiesteria piscicida*. Workshop attendees included representatives from the health departments of eight states (Delaware, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, and West Virginia) and the District of Columbia, the U.S. Food and Drug Administration, the National Institutes of Health's National Institute of Environmental Health Sciences, CDC's National Institute for Occupational Safety and Health, and the U.S. Environmental Protection Agency.

P. piscicida and morphologically related organisms (MROs) are dinoflagellates that have been implicated in recent estuarine* fish kills on the U.S. eastern seaboard and have been reported to be associated with human illness. These dinoflagellates appear similar under light microscopy and require scanning electron microscopy for definitive identification. The attendees of the workshop agreed on a combined set of environmental conditions and clinical signs and symptoms that together may represent adverse consequences of exposure to these organisms. The environmental conditions are exposure to estuarine water characterized by any of the following: 1) fish with lesions consistent with P. piscicida or MRO toxicity (20% of a sample of at least 50 fish of one species having lesions); 2) a fish kill involving fish with lesions consistent with P. piscicida or MRO toxicity; or 3) a fish kill involving fish without lesions, if P. piscicida or MROs are present and there is no alternative reason for the fish kill. The clinical features in humans include any of the following signs and symptoms: 1) memory loss, 2) confusion, 3) acute skin burning (on direct contact with water), or 4) three or more of an additional set of conditions (headaches, skin rash, eye irritation, upper respiratory irritation, muscle cramps, and gastrointestinal complaints [i.e., nausea, vomiting, diarrhea, and/or abdominal cramps]).

Workshop attendees suggested using the above framework to identify potentially affected persons and recommended initiating the following public health activities: 1) uniform multistate surveillance for potential P. piscicida- and MRO-related illness; 2) multistate, CDC-coordinated, epidemiologic studies to determine possible human health effects associated with P. piscicida and MRO exposure; and 3) identification of a biomarker of exposure to the toxins produced by these organisms. The public health implication of toxicity of these dinoflagellates is an example of an emerging environmental and potential occupational health issue that can best be addressed through collaboration among Federal, State, and local health agencies.

*A coastal area at the mouth of a river where fresh river water mixes with salty sea water.

Reported by participants in The Public Health Response to Pfiesteria Workshop: AL Hathcock, PhD, Div of Public Health, Delaware Health and Social Svcs; ME Levy, MD, District of Columbia Commission of Public Health; S Wiersma, MD, Florida Dept of Health; CL Drenzek, DVM, Div of Public Health, Georgia Dept of Human Resources; MP Wasserman, MD, Maryland State Dept of Health and Mental Hygiene; R Levine, MD, S Music, DTPH, North Carolina Dept of Health and Human Svcs; R Ball, MD, South Carolina Dept of Health and Environmental Control; SR Jenkins, VMD, Virginia State Health Dept; C Berryman, DVM, Bur of Public Health, West Virginia Dept of Health and Human Resources; Office of Public Health and Science, US Dept of Health and Human Svcs; Office of Seafood, Center for Food Safety and Applied Nutrition, US Food and Drug Administration; Geographic Planning and Technology Support Br, Water Management Div, Region IV, US Environmental Protection Agency; Laboratory of Pharmacology and Chemistry, National Institute of Environmental Health Sciences, National Institutes of Health; Hazard Evaluations and Technical Assistance Br, Div of Surveillance, Hazard Evaluations, and Field Studies, National Institute for Occupational Safety and Health, Toxicology Br, Div of Environmental Health Laboratory Sciences, and Health Studies Br, Div of Environmental Hazards and Health Effects, National Center for Environmental Health, CDC.

ATTACHMENT 2

Department of Health and Mental Hygiene
Martin P. Wasserman, M.D. J.D., Secretary

Precautions for Sampling in Area of the Pocomoke River

As a safety precaution, MDE and DHMH have advised swimmers and other recreational users of the Pocomoke River to avoid waters where a major fish kill has occurred.

Precautionary Advice: Sampling activities will continue to investigate the water quality and possible causes and consequences of *Pfiesteria's* presence in the Pocomoke River area. Based on a concern for the welfare of all employees carrying out their duties, we are issuing the following precautionary advice as a three-tiered approach to protecting those sampling surface water or other environmental media.

Tier 1 - All Maryland waters:

- Use common sense regarding contact with natural waters.
- Wearing light waterproof gloves (e.g. latex or vinyl) is recommended as sampling teams work daily under all conditions in a wide variety of waters with potential risks from different sources, both environmental and anthropogenic.
- Washing hands and other exposed areas thoroughly with soap and water after sampling is recommended. After returning home, a full shower (including hair washing) is recommended.

Tier 2 - Lower Pocomoke River (from Cedar Hall Wharf down to Williams Point):

- Wearing heavy waterproof gloves and foul weather gear is recommended.
- Washing hands and other exposed areas thoroughly with soap and water after sampling is recommended. After returning home, a full shower (including hair washing) is recommended.

Tier 3 - Areas where toxic *Pfiesteria* is suspected:

! For workers sampling in the lower Pocomoke River from Cedar Hall Wharf down to the uppermost part of Pocomoke Sound (Williams Point) during a fish kill or during a closure related to a fish kill.
  - Wear heavy waterproof gloves, foul weather gear, a half face mask with carbon filters, and goggles.
  - Avoid direct water contact with skin.
  - Wash hands and all exposed skin thoroughly with soap and water. After returning home, a full shower (including hair washing) is recommended.

! When investigating fish kills or diseased fish (i.e., you observe a significant number, ≥20%, of fish with lesions of fish are displaying erratic behavior, e.g. gulping air at surface, struggling at surface, cessation of swimming or swimming on side or back), all the protective gear and measures described directly above are recommended.

NOTE: The use of diluted bleach is **not** recommended as it can cause skin irritation, rashes, and be damaging if it comes into contact with the eyes. Equipment can be corroded using diluted bleach.

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