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LETTER FROM U S NAVY REGARDING ENVIRONMENTAL CONTAMINANT STUDIES SUMMARIES BETWEEN 1984 AND 1988 WITH TRANSMITTAL NSWC INDIAN HEAD MD
8/29/1989
NSWC INDIAN HEAD

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DEPARTMENT OF THE NAVY
NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND 20640-5000

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Ser 0433F/76
AUG 29 1989

From: Commanding Officer, Naval Ordnance Station, Indian Head, MD 20640-5000

To: Commander, Naval Energy and Environmental Support Activity, Attn: Mr. Ron Tickle, Port Hueneme, CA 93043-5014

Subj: REPORT TRANSMITTAL

Encl: (1) Report, "Environmental Contaminant Studies, A Summary", by U. S. Fish and Wildlife Service, Environmental Contaminants Branch, Annapolis and Gloucester Field Offices, 1984-1988.

1. Enclosure (1) is transmitted herewith for your use, as requested.

2. If you have any questions or require additional information, please contact Glenn Smith on AV 364-7745.

Sincerely,

PETER RITZCOVAN
By direction

United States Depaitment of the Interior

FISH AND WILDLIFE SERVICE
DIVISION OF ECOLOGICAL SERVICES
1825 VIRGINIA STREET
ANNAPOLIS, MARYLAND 21401

May 4, 1989

Memorandum

To: Recipients

From: Supervisor, Annapolis Field Office, Annapolis, MD

Subject: Report Transmittal

The accompanying report, "Environmental Contaminant Studies. A Summary. Annapolis and Gloucester Field Office, 1984-1988," is provided for your information and use. Additional information concerning the summarized contaminants studies is available from the Annapolis Field Office, Environmental Contaminants Branch (Ed Pash, Branch Chief), 301-269-5448.

Ed Pash

For John P. Wolflin

AFO-C89-3

ENVIRONMENTAL CONTAMINANT STUDIES
A SUMMARY

Annapolis and Gloucester Field Offices, 1984-1988

U.S. Fish and Wildlife Service

March, 1989

Environmental Contaminant Studies - A Summary.

Annapolis and Gloucester Field Offices,

1984 - 1988.

U.S. Fish and Wildlife Service
Environmental Contaminants Branch
Annapolis Field Office

Prepared By:
Dan Audet

Present Address:

U. S. Fish and Wildlife Service
Chesapeake Bay Estuary Program
Annapolis, MD

Under Supervision Of:

John P. Wolflin, Supervisor
Annapolis Field Office

March 1989

Title: Environmental Contaminant Studies - A Summary. Annapolis and Gloucester Field Offices, 1984-1988.

Dan Audet
March 1989

ABSTRACT: The purpose of the U.S. Fish and Wildlife Service (USFWS or FWS) Environmental Contaminants Program is to protect fish and wildlife resources from the detrimental impacts of unconventional pollutants/toxic substances/environmental contaminants, terms used synonymously in our activities. This is accomplished through sampling and monitoring contaminant levels in soil, sediment, water, plants, and animals; using bioassay techniques to determine toxicity of water or sediments; and examining ecosystem effects via measurements of species diversity and biomagnification of contaminants through the food chain. This report outlines contaminant studies performed by the Annapolis Field Office and Gloucester Field Office since 1984 in Maryland, Virginia, Delaware and West Virginia. Study descriptions are grouped into the following eight categories. Environmental Contaminant Field Studies were funded by FWS-Region 5 to evaluate fish and wildlife in areas where contaminants are known or suspected to be a problem. National Wildlife Refuge (NWR) Contaminant Studies were supported by NWR funds to evaluate fish and wildlife health in and around NWRs and other Department of Interior lands. National Pollutant Discharge Elimination System (NPDES) Studies examined bioassay toxicity and contaminant levels in aquatic organisms to determine the effectiveness of individual NPDES permits. Superfund Site Bioassessment Studies were conducted under interagency agreements with EPA Region III, and examined impacts to fish and wildlife from hazardous substances. Preliminary Natural Resource Surveys were conducted at Superfund sites at the request of EPA or Department of Interior, to provide estimates of the probability of past or present damages to trustee fish and wildlife resources; Special Studies were conducted using transfer funding or as a result of cooperative agreements for the same fish and wildlife protection objectives. Oil Spill Studies determined potential impacts to living resources under the National Contingency Plan. Finally, fish were collected from local rivers at two-year intervals for analysis under the National Contaminant Biomonitoring Program.

PREFACE

Inception of this document occurred during the gathering of data and information for the U.S. Department of Interior, Fish and Wildlife Service testimony before the House Public Works and Transportation Committee, Subcommittee on Water Resources concerning toxic pollution in Chesapeake Bay. Testimony was held on March 7, 1988, in Baltimore, Maryland. This prompted the Annapolis Field Office (AFO) of the USFWS to assemble the contained material describing all contaminant studies conducted by the AFO and the Gloucester, Virginia Field Office (GFO), a sub-office of AFO. This document includes a brief history of USFWS involvement and responsibilities with regard to environmental contaminants, a description of methods used by the field offices to determine impacts and concentrations of contaminants in biota, types of contaminant studies conducted by AFO and GFO; and listings of all contaminant field studies conducted by both field offices since 1984. A similar but less comprehensive compilation has been distributed by the Annapolis Field Office: "Summary of Chesapeake Bay Environmental Contaminant Studies, 1984-1988." (AFO-C89-1).

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ACKNOWLEDGEMENTS

Completion of this document and conduct of the studies described would not have been possible without the support of the entire AFO and GFO staff. Special recognition should go to Environmental Contaminants personnel of both offices (past and present) including Ed Pash, Steve Goodbred, David Stilwell, Don Kane, Deborah Rudis, Linda Andreasen, and David Sutherland. Ed Pash, Steve Goodbred, David Stilwell, Becky Perry, Suzanne Nair, Linda Andreasen, Elizabeth Block, Patty McCawley, and Dolores Orendorf of the field offices reviewed a number of drafts and provided editorial and technical comments. Valuable typing support was provided by Yulanda Chew, Patty McCawley, and Dolores Orendorf.

INTRODUCTION

Significant USFWS involvement with environmental contaminants began in the late 1940s when studies were initiated to determine the impacts of synthetic organochlorine pesticides, such as DDT, on fish and wildlife resources. Regional contaminant operational activities began in 1964 in the Division of Fishery Services. In 1966, these activities were expanded with the establishment of regional pesticide specialists in the Division of Wildlife Services. Their responsibilities were: 1) conduct of the newly-created National Pesticide Monitoring Program; 2) review of USFWS and USFWS-funded pesticide uses; and 3) provision of support and assistance in pesticide contamination matters. In 1976, contaminant operations, monitoring, and research activities were consolidated into the Environmental Contaminant Evaluation Program under the aegis of the Program Manager for Environment and Research.

In an effort to improve the technical expertise available to regional and field operational activities, the Division of Resource Contaminant Assessment (RCA) was formed in 1982 by the Habitat Resources Program to provide increased operational support and coordination. In 1986, the RCA program became the Environmental Contaminants (EC) Program. Presently, the USFWS EC Program maintains a Regional Coordinator in each regional office and an EC Specialist in each Fish and Wildlife Enhancement (formerly Ecological Services) field office.

The primary objective of the EC Program field offices is to protect fish and wildlife resources from the detrimental impacts of environmental contamination and to enhance those resources and their habitats whenever possible. Responsibilities of the EC Program include evaluating the health of fish and wildlife populations on lands and bodies of water where contaminant-caused health problems may exist. Areas studied include U.S. Environmental Protection Agency (EPA) Superfund sites, highly industrialized and urbanized areas, and areas of isolated chemical spills or releases. The field offices also examine terrestrial and aquatic ecosystems associated with U.S. Department of Interior lands such as National Wildlife Refuges and National Parks.

The AFO and GFO have been conducting environmental contaminant studies since 1984. This document contains reviews of all contaminant studies to date from AFO and GFO and includes information on the date(s), location(s), contaminants of concern, species of concern, background data on previous information and justification for the study, type(s) of analysis and species analyzed, brief summary of results, and comments on the study such as recommendations made, actions taken, or additional studies planned. The documentation of toxicants in contaminated areas and contaminant levels in the tissues of the biota provide the baseline information for management decisions and clean-up efforts necessary for the health of fish and wildlife resources and their habitats.

CONTAMINANT ANALYSIS

There are several accepted methods for determination of contaminant impacts on fish and wildlife resources. Three basic techniques are utilized by the AFO and GFO in contaminant studies:

Chemical analysis
Histopathological examination
Bioassay testing

Chemical Analysis. This is one of the most commonly used techniques in determining contaminant occurrence in fish and wildlife species and habitats. In general, samples are collected from three different media: substrate (soil or sediment), water, and biota. Chemical analyses are performed to determine presence and concentration of specific inorganic and organic contaminants. Several analytical methods exist, and the appropriate selection is determined considering both cost and time. For example, an ICP (Inductive Coupled Plasma Spectrometry) scan can be used to detect several metals in a single run for the purpose of determining which metals are occurring at concentrations that may be affecting the biota. An ICP scan can be conducted more inexpensively than an individual metal analysis. If initial analysis shows a problem, more sensitive quantitative analysis can then be conducted to obtain residue results for individual metals. Analysis of soil and water samples usually involves fewer problems than biota samples.

Biota samples may be processed by one of several methods. Depending on the situation, one of three sample types is generally used in analysis:

Whole body sample
Edible portion sample
Specific organ sample

Whole body samples can be used when establishing baseline data to determine if a potential contaminant problem exists. The entire organism is analyzed with no concern for whether contaminants are accumulating in a particular tissue. If a study is being conducted to determine levels of contaminants in species eaten by man (for human health studies), edible portions of an organism should be used. Procedures for this technique are established by the U.S. Food and Drug Administration (FDA). If specific organs of a species are known to bioaccumulate or bioconcentrate specific contaminants, it may be appropriate to analyze the organs of species from clean (reference) and contaminated (experimental) sites.

Histopathological Examination. Histopathology is defined as the branch of pathology concerned with tissue changes characteristic of disease. Significant histopathological changes in an organism can be linked with the presence or concentration of a particular contaminant or group of contaminants. Lesions are defined as any deviation from the normal architecture of tissues or organs which can be observed by eye or by light and electron microscopy.

Necropsy includes an initial examination of the external surface of the organism and of major organs. After the gross necropsy, selected tissues are embedded in paraffin, sectioned and stained, then examined microscopically. Any cellular changes observed are considered sublethal but are assumed to be irreversible. Cellular changes may lead to tissue damage which can lead to organ/system damage which, in turn, can cause death. While the relationship between specific contaminants and histological changes is not clearly understood for all contaminants, some generalizations can be made. In fish, organic contaminants tend to cause lesions in the liver and brain tissue, while metals cause histological changes in the kidney and gills.

Bioassay Testing. A bioassay is a standardized procedure to determine the effects of an environmental variable or substance on a living organism. In contaminant studies, organisms are exposed to water or sediment, and toxicity is measured for any or all contaminants present, including possible synergistic effects. Typically, the organism used is a small species for which the effect of a contaminant can be readily observed. Examples of species commonly used are Daphnia sp., Ceriodaphnia dubia, and fathead minnow (Pimephales promelas). Recently, an acute oyster larvae bioassay test was developed for USFWS use.

There are several bioassay methods for exposing test species to environmental contaminants. The most common method uses water or sediment collected from study sites. Acute (96 hour) and chronic (seven day) toxicity values can be obtained from these tests. The values are reported as median tolerance limit (TL_{50}) or median lethal concentration (LC_{50}). Either symbol signifies the concentration of water or sediment that kills 50% of the test organisms within the specified time span. The EC_{50} value represents the median effective concentration of a toxicant that is estimated to produce a designated effect in 50% of the test organisms. The amount of light given off by the luminescent Microtox bacteria is an example of a measured designated effect. A negative impact from sample water would result in a decrease in light output.

The caged bioassay represents a relatively new approach to exposing test species to contaminants. Test organisms from a clean environment are confined in a cage and placed in a contaminated site. The AFO plans to use the caged bioassay technique cooperatively with the State of Maryland during spring 1990.

FIELD STUDIES

The environmental contaminant studies conducted by AFO and GFO are organized into eight categories:

Environmental Contaminant Field Studies
National Wildlife Refuge Field Studies
National Pollution Discharge Elimination System Studies
Superfund Site Studies
Preliminary Natural Resource Surveys
Special Studies
Oil Spill Studies
National Contaminant Biomonitoring Program

The following sections will give a brief description of each category followed by a listing of all contaminant studies reviewed in the respective category conducted by the AFO and/or GFO. Each study listed contains information on the location of the study; contaminants of concern; species which may be affected; background information that justified the study; types of analysis used; brief summary of results; and pertinent comments on the study such as recommendations made, and actions taken to correct the problem, and additional studies planned by the field offices.

All concentrations of organic compounds in this document are reported as wet weight for biotic samples and dry weight for sediment samples, and all metals are reported as dry weight. Analytical work discussed in this document was conducted at various USFWS contract laboratories as well as other federal, state, and private laboratories. Therefore, the data of each study is documented exactly as it was received from the contracted laboratory.

Environmental Contaminant Field Studies

Each fiscal year, the AFO and GFO receive EC funding from the regional office (USFWS Region 5, Newton Corner, Massachusetts) to evaluate fish and wildlife on lands and bodies of water where contaminants may have caused health problems. Projects range from small isolated areas of concern to entire river systems. Regionally-funded projects conducted since 1984 are listed in Table 1. Locations of these studies are shown in Figure 1.

Table 1. Environmental Contaminant Field Studies.

Elizabeth River Polynuclear Aromatic Hydrocarbon Study (1984)
Patapsco Estuary Contaminant Study (1985)
Loggerhead Shrike Contaminant Study (1985-1986)
Kanawha River Contaminant Study (1986-1987)
Potomac and Anacostia Rivers - Organochlorine and PCBs Study (1987)
Patuxent River Chlordane Study (1988)
James River Eagle Prey Contaminant Study (1988)
Delaware River/Bay Contaminant Study (1988-1989)

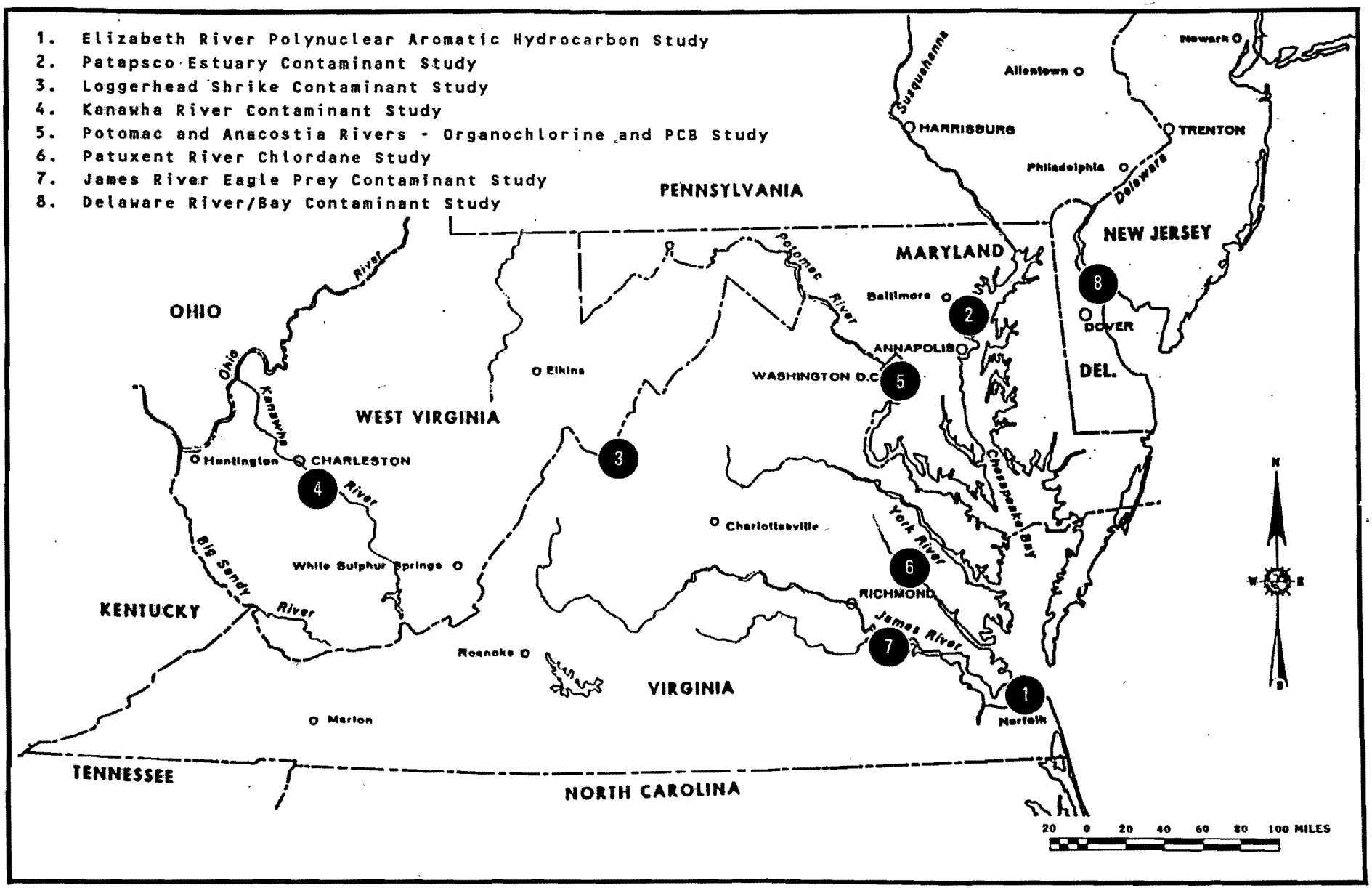

FIGURE 1. Locations of Environmental Contaminant Field Studies conducted by AFO and GFO.

Project	:	**Elizabeth River Polynuclear Aromatic Hydrocarbon Study**
Period of Study	:	1984
Location	:	Elizabeth River, City of Norfolk, Virginia
Contaminants of Concern	:	Polynuclear aromatic hydrocarbons (PAHs)
Species of Concern	:	All anadromous and other fish
Background Data	:	In 1981, the Virginia Institute of Marine Sciences and Old Dominion University collected and analyzed sediments of the Elizabeth River. Sediments were shown to contain heavy metals, pesticides, and PAHs. Copper and lead levels found in the river sediments were more than 10 times greater in magnitude than levels found in Chesapeake Bay. Cadmium levels were 58 times greater in magnitude than Bay levels. Sediment bioassays demonstrated lethal effects, and metals accumulated in tissues of test organisms exposed to sediments of the river.
Type(s) of Analysis and Species Analyzed	:	Whole body chemical analysis of American eel (Anguilla rostrata), Atlantic croaker (Micropogonias undulatis), weakfish (Cynoscion regalis), red hake (Urophycis chuss), hogchoker (Trinectes maculatus), and spot (Leiostomus xanthurus).
Results	:	Sixteen PAHs were targeted in the chemical analysis. In five species of fish, PAHs were detected more frequently and were of a greater magnitude at the experimental sampling site than at the reference sampling site.
Comments	:	Since 1984, the Virginia State Water Control Board has conducted extensive studies of the Elizabeth River, and more current data is available.

Project	:	**Patapsco Estuary Contaminant Study**
Period of Study	:	1985
Location	:	Patapsco and Magothy Rivers, Bear Creek, Curtis Bay, and Baltimore Harbor, Baltimore and Anne Arundel Counties and Baltimore City, Maryland
Contaminants of Concern	:	Chlordane, polychlorinated biphenyls (PCBs), PAHs, and possibly metals
Species of Concern	:	All anadromous and other fish
Background Data	:	In 1982, EPA documented that diversity of benthic invertebrates declined in general along a gradient of increasing contamination of metals and organics in Baltimore area waters. In Patapsco estuary, areas of reduced diversity showed a strong correspondence with both metal and organic contamination of sediment. PAHs have been found in sediments at levels greater than 50 ppm in Baltimore Harbor, Bear Creek, Curtis Bay, and Patapsco River. Metal contamination was 50 times greater than naturally occurring levels in sediments at Baltimore Harbor, Curtis Bay, and Patapsco River. Also, results from bioassays performed with Patapsco River sediments showed a correlation between levels of nickel and zinc and survival of an amphipod (Rhepoxynius abronius).
Type(s) of Analysis and Species Analyzed	:	Whole body chemical analysis of spot, hogchoker, white perch (Morone americana), white catfish (Ictalurus catus), summer flounder (Paralichthys dentatus), bluegill (Lepomis macrochirus), and channel catfish (Ictalurus punctaus). Blue crabs (Callinectes sapidus) were also analyzed.
Results	:	Maximum chlordane concentration levels in fish ranged from 0.369 ppm in Curtis Bay to 0.402 ppm in Baltimore Harbor. Total PCB concentrations ranged as high as 5.04 ppm in Baltimore Harbor to 9.70 ppm in Curtis Bay. Five of seven fish collected in Baltimore Harbor had levels greater than 0.30 ppm chlordane and/or 2.0 ppm PCBs.

Comments : Results of this study received extensive coverage in the Washington Post, Baltimore Sun, and the Annapolis Capital newspapers. Shortly after the completion of this study, a state sampling program was established in the Patapsco Estuary. In 1988, a multi-agency project (USFWS, EPA, University of Maryland, and Maryland Department of Natural Resources) was planned in detail to determine the impacts of heavy industrial contamination. Caged fish will be placed in Curtis Bay and will be examined histopathologically and immunologically over a course of two months beginning in 1990.

Project	:	**Loggerhead Shrike Contaminant Study**
Period of Study	:	1985-1986
Location	:	Augusta, Highland, and Rockingham Counties, Virginia
Contaminants of Concern	:	Organochlorine pesticides, mercury, and selenium
Species of Concern	:	Loggerhead shrike (Lanius ludovicianus) and any other predatory bird species in the vicinity of the study area
Background Data	:	In 1986, the AFO was asked by Virginia Polytechnic Institute and State University (VPI) to analyze shrike eggs which they had collected in northwestern Virginia. The Shenandoah Valley shrike population has declined drastically over the past 20 years. Recent data documented evidence of unusual persistence of organochlorine pesticides in certain mammals and birds collected in fruit orchard habitats similar to those found in the Shenandoah Valley.
Type(s) of Analysis and Species Analyzed	:	Chemical analysis was completed on 21 loggerhead shrike eggs. Eggs were collected from abandoned nests and nests where all viable eggs had hatched. Measurements of egg length and breadth were also taken.
Results	:	Eggs were analyzed in five lots ranging from one to five eggs per lot. Selenium concentrations in the eggs ranged from 1.5 to 2.0 ppm, while mercury ranged from 0.03 to 0.11 ppm. Chlordane levels for the five lots were 0.068, 0.135, 0.108, 0.164, and 0.155 ppm. Dieldrin levels for the five lots were 0.020, 0.013, 0.007, 0.045, and 0.024 ppm. Polychlorinated biphenyl concentrations ranged from 0.24 to 1.30 ppm. The DDE levels were an order of magnitude or more higher than other DDT metabolites detected. The DDE concentrations varied the most with values of 0.550, 0.570, 1.40, 2.30, and 26.0 ppm. The 26.0 ppm value (from a lot of five eggs) is above the concentration level of DDE which is considered to cause eggshell thinning and population decline.
Comments	:	Future investigations are planned by both VPI and AFO.

Project	:	**Kanawha River Contaminant Study**
Period of Study	:	1986-1987
Location	:	Kanawha River from Montgomery, West Virginia downstream to Buffalo, Kanawha and Putnam Counties, West Virginia
Contaminants of Concern	:	Organochlorines and metals
Species of Concern	:	Freshwater fish and migratory waterfowl
Background Data	:	The portion of river studied contained three dams. These dams created four regions or "reaches" separated by physical barriers (dams). The spatial distribution appeared to be suited to establishing pre-impact, impact, and post-impact regions, with the impact reach defined as that most heavily affected by anthropogenic contamination. Since the river represents a highly industrialized waterway with segments moving through the cities of Charleston and Institute, West Virginia, information obtained about the effects of industrial wastes on fish health will be of great value. Several chemical spills have taken place and serious impacts may have occurred to the aquatic community. Samples of largemouth bass (Micropterus salmoides) and smallmouth bass (Micropterus dolomieui) collected by USFWS Elkins office have shown types of lesions which are induced by parasites.
Type(s) of Analysis and Species Analyzed	:	(1) Whole body chemical analysis of channel catfish. (2) Chemical analysis of sediment. (3) Histopathological examination of channel catfish.
Results	:	Results have not been interpreted at this time.
Comments	:	This study was conducted in cooperation with the USFWS Elkins Office and the West Virginia Department of Natural Resources.

Project	:	**Potomac and Anacostia Rivers - Organochlorine and PCBs Study**
Period of Study	:	1987
Location	:	Washington D.C. portion of Potomac and Anacostia Rivers
Contaminants of Concern	:	Chlordane and PCBs
Species of Concern	:	All anadromous and other fish
Background Data	:	A comparison of 1980 and 1985 D.C. Fisheries Program contaminant data of fish showed an increase in lead, mercury, and PCBs in the Potomac River and an increase in lead, mercury, copper, and PCBs in the Anacostia River. In 1986, D.C. Fisheries collected fish samples from both the Potomac and Anacostia Rivers which revealed concentrations of PCBs and chlordane above FDA action levels. In 1987, D.C. Fisheries requested the AFO to conduct a contaminant study on the rivers.
Type(s) of Analysis and Species Analyzed	:	(1) Whole body chemical analysis of largemouth bass, channel catfish, and white catfish. (2) Chemical analysis of fillets from largemouth bass, channel catfish, and white catfish. (3) Chemical analysis of sediment. (4) Histopathological examination of brown bullhead (Ictalurus nebulosus).
Results	:	Whole body chemical analysis. Chlordane levels in whole body samples were as high as 0.55 ppm in the Potomac River and Washington Channel and 0.80 ppm in the Anacostia River. PCBs levels in whole body samples were as high as 6.3 ppm in the Potomac River and 4.6 ppm in the Anacostia River. Chemical analysis of fillets. Edible portion (fillet) samples had chlordane levels as high as 0.38 ppm in the Potomac River and 0.64 ppm in the Anacostia River. A fillet sample of fish from the Potomac River had 3.1 ppm of PCBs. The National Contaminant Biomonitoring Program's (NCBP) average chlordane level for the past 12

years has been 0.15 ppm. The FDA action level for chlordane is 0.3 ppm and the FDA tolerance level for PCBs is 2.0 ppm.

Chemical analysis of sediment. Organochlorines were not detected in sediment samples from the Potomac River and Washington Channel. Levels of contaminants from Anacostia River ranged from non-detectable to 0.05 ppm for chlordane and 0.04 ppm for DDE.

Histopathological examination. Histopathological examination of brown bullheads has not been completed.

Comments : The D.C. Fisheries Program has planned a detailed sampling agenda to determine the extent of chlordane and PCBs contamination. A determination of all major point and non-point sources of chlordane and PCBs is needed for an appropriate abatement program to be initiated.

Project:	:	**Patuxent River Chlordane Study**
Period of Study	:	1988
Location	:	Nontidal freshwater portion of Patuxent River, Laurel to Davidsonville, Prince Georges and Anne Arundel Counties, Maryland
Contaminants of Concern	:	Chlordane
Species of Concern	:	All anadromous and other fish
Background Data	:	Since 1977, the Maryland Office of Environmental Protection (OEP) has been conducting a statewide fish tissue analysis for organic compounds, including chlordane, as part of the federally mandated Basic Water Monitoring Program. In general, the levels of chlordane found in fish tissue were well below the FDA action levels. Some rivers (Bush, Chester, Choptank, Gunpowder, Patapsco, Patuxent, Potomac and Susquehanna Rivers) had fish with chlordane concentrations above FDA action levels. The Patuxent River has had a comparatively high frequency of samples above the FDA action level for chlordane, approximately 6% of all fish collected since 1977. Chlordane levels as high as 0.88 ppm have been reported from bluegill collected in the freshwater portion of the Patuxent River. Other fish species analyzed from the Patuxent River with high levels ($\geq$ 0.3 ppm) of chlordane include brown bullhead, white sucker (Catostomus commersoni), and fallfish (Semotilus corporalis). While these high levels are well documented, there is little understanding of the extent and geographic distribution of chlordane bioaccumulation in fish of the Patuxent River.
Type(s) of Analysis and Species Analyzed	:	(1) Whole body and fillet chemical analysis of brown bullhead and white catfish. (2) Chemical analysis of sediment.
Results	:	All fish samples contained low levels of several organochlorines. Contaminants above quantification level in whole body brown bullhead samples included chlordane (0.03-0.20 ppm), PCBs (0.05-1.40 ppm), DDE (0.01-0.19 ppm), and dieldrin (< 0.02 ppm). These compounds occurred

in fillet samples at similar but slightly lower concentrations. Highest concentrations were detected in individuals collected from around the Route 214 bridge near Davidsonville. White catfish were divided into fillet and carcass samples for analysis. One of two catfish collected just below Fort Meade on the Little Patuxent contained high levels of toxaphene (4.70 in the carcass sample), DDT metabolites (DDE, 10.0; DDD, 3.20; DDT, 0.77 in carcass), and PCBs (0.40 in fillet).

No chlordane or other organochlorines were detected in sediment.

Project	:	**James River Eagle Prey Contaminant Study**
Period of Study	:	1988
Location	:	James River, downstream of Hopewell, Prince George County, Virginia, the largest post-breeding summer roost of bald eagles (> 100 eagles) in the eastern United States.
Contaminants of Concern	:	Organochlorines, PAHs, and metals
Species of Concern	:	Bald Eagles (Haliaeetus leucocephalus)
Background Data	:	Several contaminant point sources may affect bald eagles in this area. Hopewell Sewage Treatment Plant (STP) is a municipal waste treatment facility which processes 90-95% industrial wastewater and 5-10% sanitary waste. The level of chromium (100 ppb) found in Hopewell's effluent exceeded chronic toxicity values reported for freshwater organisms in reference to both trivalent and hexavalent chromium. High levels of PCBs and PAHs were also reported in the effluent. In a study by the Virginia Water Control Board, several organic compounds and metals were found to be bioaccumulating in the Asiatic clam (Corbicula manilensis) and were traced to effluent from Allied Chemical (see also Presquile NWR Contaminant Study summary). Another upstream point source of concern was Chesterfield Power Plant with known discharges of metals. It was important to determine whether eagle health was at risk from possible dietary exposure to contaminants.
Type(s) of Analysis and Species Analyzed	:	(1) Whole body chemical analysis of white catfish and gizzard shad (Dorosoma cepedianum).
Results	:	Study not completed

Project	:	**Delaware River/Bay Contaminant Study**
Period of Study	:	1988-1989
Location	:	Delaware River/Bay from just north of Wilmington, Delaware downstream to Cape May, New Jersey
Contaminants of Concern	:	Organochlorines and metals
Species of Concern	:	Anadromous and other fish, including the anadromous striped bass (Morone saxatilis), American shad (Alosa sapidossima), and the federally endangered shortnose sturgeon (Acipenser brevirostrum). Also of concern are migratory waterfowl, bald eagles, and ospreys (Pandion haliaetus)
Background Data	:	A recent study of the Delaware River in the Philadelphia area indicated that toxicants in the river could be causing fish health problems. The problems included liver and lip tumors, liver lesions, and gill lesions, all of which may have been caused by environmental contaminants. Also, several organic and inorganic contaminants in fish were found during this study. PCBs in six of seven composite channel catfish fillet samples were above the FDA action level of 2.0 ppm. Chlordane was also detected but was not quantified, and no conclusions could be drawn on its potential accumulation levels. Pennsylvania state agencies recommended that a fish consumption advisory be considered for the Delaware River and Estuary. Since the State of Delaware had no tissue data to support this advisory, it was essential that adequate data be obtained.
Type(s) of Analysis and Species Analyzed	:	(1) Whole body chemical analysis of white catfish, weakfish, white perch, and blue crabs. (2) Chemical analysis of fillets from white catfish, weakfish, and white perch. (3) Chemical analysis of sediment.
Results	:	Study not completed.

National Wildlife Refuge (NWR) Contaminant Studies

The USFWS Fish and Wildlife Enhancement field offices are responsible for evaluating fish and wildlife health in terrestrial and aquatic ecosystems on or surrounding U.S. Department of Interior lands, including NWRs. In general, the NWRs of the Delaware, Maryland, Virginia tri-state area provide wintering and nesting habitat for waterfowl, colonial waterbirds, passerine birds, and birds of prey, including the endangered bald eagle and peregrine falcon. Some refuges also provide important feeding and spawning grounds for anadromous fish. For the past few years, the AFO and GFO have received NWR funds to conduct environmental contaminant studies on or near NWRs. A list of NWR studies initiated by the two field offices is given in Table 2. Locations of these refuges are shown in Figure 2. Future plans for NWR contaminant studies include Eastern Neck NWR, Plum Tree Island NWR, and Great Dismal Swamp NWR.

Table 2. National Wildlife Refuge (NWR) Contaminant Studies.

Glen L. Martin NWR Osprey Egg Contaminant Study (1986)
Great Dismal Swamp NWR Contaminant Study (1987)
Mason Neck NWR Contaminant Study (1987)
Presquile NWR Contaminant Study (1988)

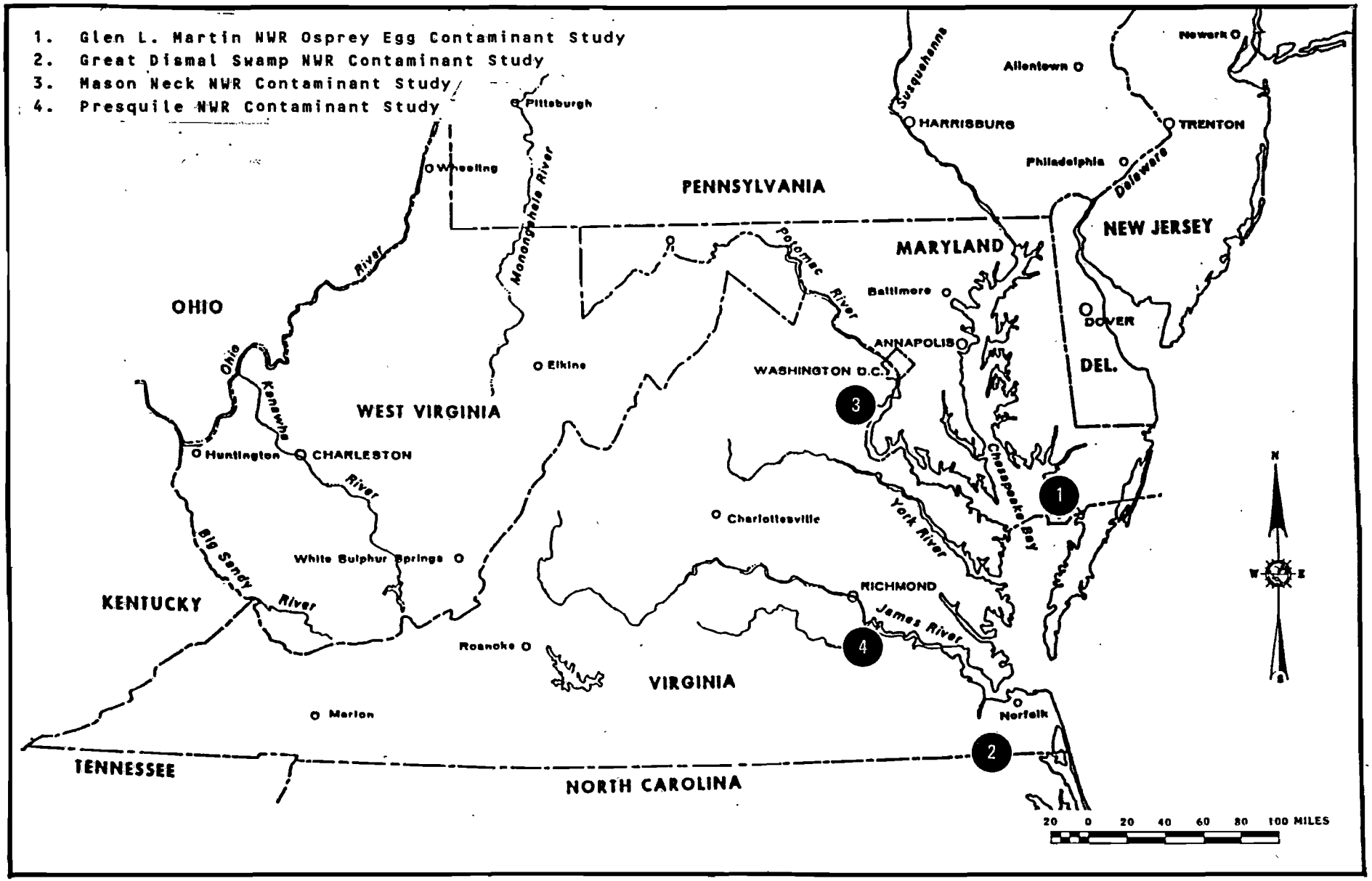

FIGURE 2. Locations of National Wildlife Refuge (NWR) Contaminant Studies conducted by AFO and GFO.

Project	:	**Glen L. Martin NWR Osprey Egg Contaminant Study**
Period of Study	:	1986
Location	:	Glen L. Martin NWR, Smith Island, Somerset County, Maryland
Contaminants of Concern	:	Organochlorines, PCBs, and metals
Species of Concern	:	Osprey
Background Data	:	Since 1980, USFWS noted a trend that, although egg numbers had increased, survival to fledging had not increased accordingly and had decreased to some degree from the mid-1970 levels. A variety of possible explanations were examined to determine the exact cause of this problem. Predation by gulls and crows, human disturbance, over-saturation of the nesting territories, lack of food available to adults, use of platforms by sub-adult birds, and contaminant levels in eggs were all considered. Since contaminants were checked in osprey eggs during the early 1970s, a comparison with 1986 levels could be made. In 1986, Glen L. Martin NWR staff proposed a contaminant study to be coordinated through the AFO and Patuxent Wildlife Research Center.
Type(s) of Analysis and Species Analyzed	:	Chemical analysis of five freshly-laid osprey eggs.
Results	:	DDE and PCBs were found in all five osprey eggs. Concentrations of DDE ranged from 0.08 - 2.8 ppm and PCBs ranged from 0.57 - 2.1 ppm. These levels represented a decrease compared to 1970 data. While DDE levels appeared high and eggshell thinning may still occur to a small degree, osprey reproductive problems are probably not due to bioaccumulation of organochlorines.

The concentration of mercury ranged from 0.44 - 1.5 ppm. These levels also are not believed to represent a threat to the osprey eggs.

Comments:

While it appears that contaminants in eggs are not the major cause of increased osprey nestling mortality, more data may be needed on contaminant exposure of nestlings. In 1987, the AFO's Chesapeake Bay Restoration Program funded a study to determine the relationship between osprey nestling mortality and decreased food supply for Chesapeake Bay osprey populations. Results from this study showed decreased food supply may be involved; but other factors such as gull and crow predation, human disturbance, and increase in sub-adults use of nesting platforms need to be addressed.

Project	:	**Great Dismal Swamp NWR Contaminant Study**
Period of Study	:	1987
Location	:	Great Dismal Swamp, Suffolk Landfill, Suffolk, Virginia
Contaminants of Concern	:	Organochlorines, aliphatic hydrocarbons, PAHs, and metals
Species of Concern	:	Migratory birds and the threatened Dismal Swamp southeastern shrew (Sorex longirostris fisheri)
Background Data	:	Surface water enters the Refuge from an inactive landfill, active junk yards, and agricultural drainage. This study was initiated as part of USFWS's efforts to address possible contaminant issues on USFWS lands.
Type(s) of Analysis and Species Analyzed	:	(1) Whole body chemical analysis of golden shiner (Notemigonus crysoleucas), yellow bullhead (Ictalurus natalis), yellow perch (Perca flavescens), flier (Centrarchus macropterus), short-tailed shrew (Blarina brevicauda), and white-footed mouse (Peromyscus leucopus). (2) Chemical analysis of sediment and soil.
Results	:	Awaiting laboratory results.

Project	:	**Mason Neck NWR Contaminant Study**
Period of Study	:	1987
Location	:	Accotink and Pohick Creeks, and Gunston Cove near Mason Neck NWR, Woodbridge, Fairfax County, Virginia
Contaminants of Concern	:	Organochlorines and heavy metals
Species of Concern	:	All anadromous and other fish, wintering bald eagles and waterfowl, nesting bald eagles and great blue herons (Ardea herodias)
Background Data	:	Review of USFWS data revealed that lesion incidence in brown bullheads at Accotink Creek was higher than expected (>50 %) based on comparison with populations taken from a reference site (see Accotink Creek Histopathology Study review). Incidence rates approached that of a highly impacted system. The lesions were suggestive of a toxin that affects lipid-rich organs such as nerves and livers. Kidneys were affected, which is compatible with an organic toxin but not specific to it. Contaminants present in fish and sediment in Accotink and Pohick Creeks needs to be identified. Bullheads and other catfish species make up over 50% of food found at eagle nest sites. Suspected organic contamination may originate from neighboring Fort Belvoir. Heavy metal contamination may originate from a sewage treatment plant on Pohick Creek where high chlorine levels have already been documented.
Type(s) of Analysis and Species Analyzed	:	(1) Whole body chemical analysis of brown bullheads. (2) Chemical analysis of sediment.
Results	:	Awaiting laboratory results.

Project	:	**Presquile NWR - Contaminant Study**
Period of Study	:	1988
Location	:	James River, near Hopewell, Prince George County, Virginia
Contaminants of Concern	:	Organochlorines and non-standard contaminants including octahydrodibenzothiophene-1-one (OHDTO), dehydroabietane, dibenzothiophene, 2 cyclohexyl-cyclohexanone, diterpenoid
Species of Concern	:	Wintering waterfowl, bald eagles, and all anadromous and other fish
Background Data	:	Hopewell Sewage Treatment Plant (STP) is a municipal waste treatment facility which processes 90-95% industrial wastewater and 5-10% sanitary waste. The proximity of the Hopewell STP to Presquile NWR supported the need to investigate any impacts to fish and wildlife from this point source of concern. In a study by the Virginia Water Control Board, OHDTO and several other organic compounds were found to be bioaccumulating in the Asiatic clam (Corbicula manilensis) and were traced to effluent from Allied Chemical, which produces the compound "caprolactum", used in the carpet manufacturing industry. OHDTO is an oxygenated form of bibenzothiophene (used in producing caprolactum). It appears to be a persistent compound with a high potential to bioaccumulate in tissue (log P of 4.8). An LC_{50} of <5 ppm has been reported for bluegills. Several other organic compounds identified in Hopewell's effluent were found to significantly bioaccumulate in clams including dehydroabietane (log P = 8.58), dibenzothiophene (log P = 4.55), 2 cyclohexyl-cyclohexanone, diterpenoid, and 4,9 dimethyl naptho(2,3-b)thiophene. In the same study by the Virginia Water Control Board, five priority metals that were detected in the effluent were also present in clam tissue. Although levels of metals in clam tissue were not high, the level of chromium (100 ppb) found in Hopewell's effluent exceeded chronic toxicity values reported for freshwater organisms in reference to both trivalent and hexavalent chromium. High levels of PCBs and PAHs were also reported in the effluent.

Type(s) of Analysis and Species Analyzed :

(1) Whole body chemical analysis of striped bass and channel catfish.

(2) Chemical analysis of fillet samples of striped bass and channel catfish.

(3) Chemical analysis of carcass samples of striped bass and channel catfish.

(4) Chemical analysis of sediment.

(5) Sediment bioassay.

Results : Awaiting laboratory results

National Pollution Discharge Elimination System (NPDES) Studies

The NPDES Program was established in response to mandates in the Clean Water Act (1972). The program requires discharge permits for point source discharges and requires that industrial discharges into publicly owned treatment plants meet pretreatment standards. The NPDES studies conducted by USFWS were part of the Chesapeake Bay Restoration Program's initial Point Source Pollution Objective. The primary task within this objective was to determine the effectiveness of certain permits issued under NPDES. By examining toxic burdens in aquatic organisms living within a discharge plume, a broad assessment can be made of the effectiveness of the individual NPDES permit. Four NPDES permit sites (Table 3) were chosen for USFWS studies. Locations of these sites are shown in Figure 3.

Table 3. National Pollution Discharge Elimination System Studies.

Spectron, Inc., Elkton, Cecil County, Maryland[1]
Nuodex, Inc., Worton, Kent County, Maryland (1985)
Chesterfield Power Plant, Chesterfield, Chesterfield County, Virginia (1985-1988)
Indian Head Naval Ordnance Station, Indian Head, Charles County, Maryland (1985-1987)

1 Efforts by the State of Maryland closed Spectron, Inc. before USFWS began its study.

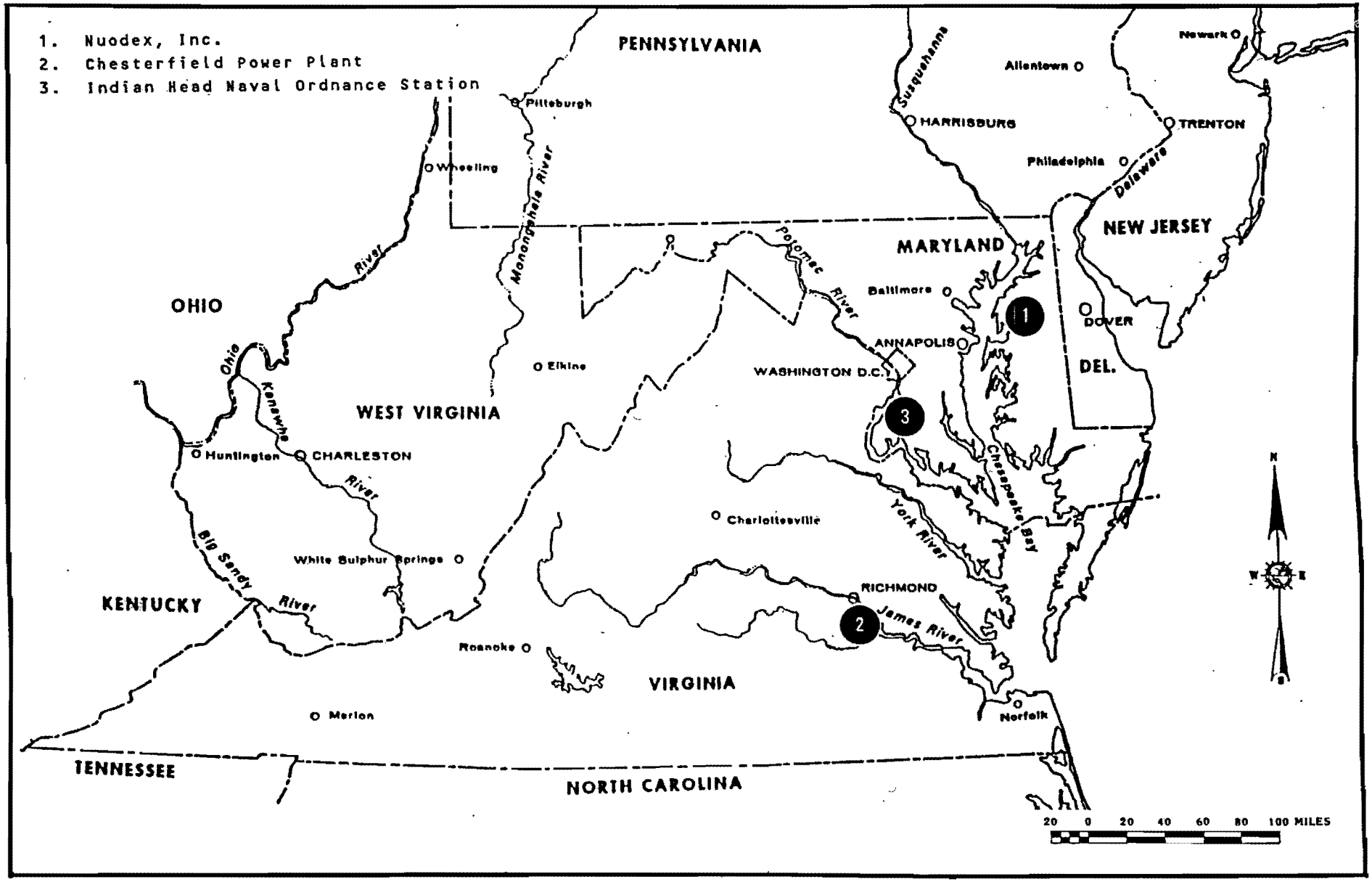

FIGURE 3. Locations of National Pollution Discharge Elimination System studies conducted by AFO and GFO.

Project	:	**Nuodex NPDES Contaminant Study**
Period of Study	:	1985
Location	:	Nuodex, Inc., Chestertown, Kent County, Maryland
Contaminants of Concern	:	Zinc and phthalate esters including di-n-octyl phthalate (DOP), di-iso-decyl phthalate, di(2-ethylhexyl) phthalate (DEHP), di-tridecyl phthalate, and hexyl-m decyl phthalate
Species of Concern	:	Migratory waterfowl, anadromous and other fish
Background Data	:	Nuodex, Inc. discharges phthalate esters into a pond which drains into Morgan Creek, which empties into the Chester River. This facility was selected for study to meet these objectives: (1) To determine if the plant was in violation of NPDES permit standards. (2) To determine the adequacy of current NPDES standards for protection of Morgan Creek and Chester River biota.
Type(s) of Analysis and Species Analyzed	:	(1) Chemical analysis of liver of snapping turtles (Chelydra serpentina) and eastern painted turtles (Chrysemys picta) for zinc. (2) Chemical analysis of fat from snapping and painted turtles for phthalate esters. (3) Chemical analysis of sediment. (4) Bioassays with water collected from three sampling sites.
Results	:	Chemical analysis of turtle tissues. Concentrations of zinc in turtle livers ranged from 12 to 28 ppm with similar levels found in both the reference and discharge ponds. Zinc in snapping turtle livers was several ppm higher than in painted turtles regardless of location. DOP and DEHP was found in all discharge and reference fat samples but mostly at concentrations too low to be quantified with the analysis method used. One sample from a painted turtle collected at the discharge pond was found to have a DEHP concentration of 30 ppm.

Chemical analysis of sediment. Concentrations of zinc in the sediment samples ranged from 14.0 to 43.0 ppm at the reference pond and 17.0 to 52.0 ppm at the discharge pond. Levels of DEHP from the discharge pond ranged from 4.1 to 37.0 ppm and were detected in all reference samples at unquantifiable levels, with one exception of 0.11 ppm. DOP was found in all reference and discharge samples at concentrations too low to be quantified.

Bioassay. The discharge water was acutely and chronically toxic to Ceriodaphnia dubia. The acute LC_{50} (percent of water from the sample site that caused 50% mortality in a 96 hour period) was 43.8%. The chronic value (tested over a seven day period) was 17.32%. The fathead minnows were also adversely impacted at this site. The LC_{50} was 96.2%, and the chronic value was 54.8%. Water from this site was moderately toxic to the Microtox bacteria. The Microtox EC_{50} was 50% at five minutes and 56% at 15 minutes.

The pond water had no adverse impact on the fathead minnows. Toxic effects could not be determined in Ceriodaphnia due to the abundance of protozoans in the water sample. The five minute Microtox EC_{50} was 37%, and the 15 minute EC_{50} dropped to 25%. This water would be classified as being moderately toxic to the Microtox bacteria.

The downstream water also had an abundance of protozoans. Toxic effects could not be determined in Ceriodaphnia. There was no adverse impact on the fathead minnows. The five minute and 15 minute EC_{50} for the Microtox were both 32%, indicating that the water was moderately toxic to the test organisms.

Comments : Since 1986, the Maryland OEP has conducted detailed biological studies of Nuodex. Areal richness and Shannon-Wiener Diversity Indices at the Nuodex pond were significantly lower than at a reference site. The results of a comparison of density of organisms between Nuodex and the reference site varied dependent on colonization period. Future studies are planned for this area.

Project	:	**Chesterfield Power Plant NPDES Study**
Period of Study	:	1985-1988
Location	:	James River, Chesterfield County, Virginia
Contaminants of Concern	:	Vanadium, selenium, cobalt, copper, and molybdenum
Species of Concern	:	Anadromous and other fish, waterfowl, osprey, and bald eagle
Background Data	:	The Chesterfield Power Plant is a coal-burning plant with known discharges of metals. The plant was selected for study to meet these objectives: (1) To determine if the plant was in violation of National Pollution Discharge Elimination System (NPDES) permit standards. (2) To determine the adequacy of current NPDES standards for protection of the river's biota. (3) To determine if contaminants from the plant are influencing resources downstream at Presquile NWR.
Type(s) of Analysis and Species Analyzed	:	(1) Whole body chemical analysis of smallmouth bass, gizzard shad, channel catfish, and blue catfish (Ictalurus furcatus). (2) Chemical analysis of sediment. (3) Bioassays with water collected from discharge and reference sites. (4) Histopathological examination of white catfish.
Results	:	Whole body chemical analysis. Currently available data analysis showed that five metals have bioaccumulated in fish at the discharge site. These levels were significantly higher than in fish from a reference site upstream of the power plant. Three species of fish collected had significantly higher levels of vanadium and selenium at the discharge site than at the reference site. Two species of fish collected had

significantly higher levels of molybdenum, cobalt, and copper at the discharge site than at the reference site.

Chemical analysis of sediment. Available data analysis showed that five metals (arsenic, cadmium, cobalt, lead, and vanadium) had significantly higher concentrations at the discharge site.

Bioassay. The survival and growth of fathead minnows was nearly identical at the reference and discharge sites. There was 95% survival in water collected from both sites. The mean weight of the fish at the reference site was 0.27 milligrams, while that at the discharge site was 0.28 mg. Fathead minnows were not affected by the discharge.

One hundred percent of the Ceriodaphnia dubia survived for the duration of the test at both sites. The mean number of young produced at the reference and discharge sites were 33.10 and 28.90, respectively. Statistically, these two groups were significantly different. However, the normal mean number of young produced in good quality surface water ranges from 25 to 35, and reproduction in the discharge water falls within this range. Based on this information, Ceriodaphnia dubia were not adversely impacted by the discharge.

The Microtox bacteria were not negatively affected by the discharge. The data suggest that they were slightly stimulated. The reference site produced a 2% increase in light output, and the discharge site produced an 8% light increase.

Histopathology. Histopathological examination of white catfish has not been completed.

Comments : No recommendations will be made until all data has been analyzed.

Project	:	**Indian Head Naval Ordnance Station (NOS) NPDES Study**
Period of Study	:	1985-1987
Location	:	Mattawoman Creek, tributary of Potomac River, Charles County, Maryland
Contaminants of Concern	:	Heavy metals
Species of Concern	:	All anadromous and other fish
Background Data	:	The Indian Head NOS manufactures, tests, and conducts research and development on gun and rocket propellants and related substances. They have 49 separate discharge outfalls with a total average flow of 4.6 million gallons per day. Previous NPDES documents reported 12 major contaminants in the discharges with methyl cellulose, cyanide, lead, and methylene chloride accounting for over 99% of the total daily discharge loading.
Type(s) of Analysis and Species Analyzed	:	(1) Whole body chemical analysis of channel catfish, gizzard shad, brown bullhead, white perch, spot, black crappie (Pomoxis nigromachulatus), brackish water clam (Rangia cuneata), and Asiatic clam. (2) Chemical analysis of spatter dock (Nuphar luteum). (3) Chemical analysis of sediment. (4) Bioassays with water collected from experimental (Marsh Island) and reference (upstream) sites. (5) Histopathological examination of brown bullhead.
Results	:	Whole body chemical analysis. There were no significant differences in mean mercury values in channel catfish, gizzard shad, and spatter dock between the Marsh Island and reference sites.

Among fish collected from Marsh Island, both gizzard shad and spot had the lowest mean mercury concentrations (0.01 ppm), and channel catfish had the highest (0.06 ppm). No mercury was detected in one black crappie sample. This species was not included in statistical analysis due to small sample size. The highest concentration of mercury in an individual fish was 0.07 ppm found in a channel catfish from Marsh Island.

Mercury concentrations in spot and white perch from the Marsh Island site were below means from the lower (tidal) Potomac River. Four of five fish species from Marsh Island had mean mercury concentrations lower or equal to those found in Chesapeake Bay. Mercury concentrations at Marsh Island were well below the national mean of 0.11 ppm.

Data from bivalves was not statistically comparable between the two sites because different species were collected and sample sizes were too small. The one sample collected at the reference site had no detectable mercury, and the mean value at Marsh Island was 0.02 ppm.

Chemical analysis of aquatic vegetation. Mean mercury concentrations for spatter dock were not significantly different between sites. Only one in five plants at each site had a quantifiable value, 0.08 ppm of mercury at the reference site control and 0.02 ppm at Marsh Island.

Biota did not seem to be bioaccumulating mercury to detrimental levels at Marsh Island. However, additional data would enable a more confident conclusion.

Chemical analysis of sediment. Six of the eight metals analyzed for were found to be significantly higher at Marsh Island. These metals were silver, arsenic, copper, lead, selenium and zinc. Concentrations of mercury and cadmium were not significantly different between sites.

Bioassays. The reference site and the Marsh Island site had fathead minnow survival rates of 90% and 100%, respectively; these were not significantly different. Mean weight of fathead minnows exposed to water downstream from the NOS discharge was significantly greater (0.28 mg versus 0.18 mg from the reference site).

There were no Ceriodaphnia dubia mortalities from water at either site. The mean number of young produced in reference and Marsh Island water was 36.30 and 33.10, respectively. While this is a significant difference, the number of young produced in Marsh Island water was well within the range of young produced in good quality surface water (25-35). The Indian Head outflow did not adversely affect the reproduction of Ceriodaphnia dubia.

Water from the reference site caused a 17% reduction in light output by the Microtox bacteria. In contrast, the Marsh Island water only caused a 2% reduction in light output. Negative effects to Microtox bacteria were greater in the reference site water.

Histopathological examination. The 1987 histopathological examination was a continuation of the 1985 study to identify possible contaminant-specific structural or functional lesions in fish. There was no significant difference in the number of parasitic lesions between the two sites, but there were more non-parasitic lesions in fish from the Marsh Island site. More fish need to be examined before a conclusive interpretation can be made.

Comments : This extensive study was the result of coordination between USFWS, Maryland OEP, and U.S. Navy personnel from both Indian Head NOS and the Navy's Chesapeake Division in Washington, DC. A final report of this study is in preparation.

Superfund Site Bioassessment Studies

The Clean Water Act and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requires the U.S. Department of Interior to address impacts to fish and wildlife resulting from hazardous chemicals found on National Priority List (NPL) Superfund Sites. The AFO and GFO have conducted biological assessments of NPL sites under an Interagency Agreement (IAG) with EPA Region III (Philadelphia, Pennsylvania) since 1985. These biological assessments are part of EPA-required Remedial Investigations of NPL sites. Biological assessments utilize several methodologies to document impacts of contaminants on natural resources including biological inventory, water and sediment bioassays, body burden analysis, and histopathology. Biological assessments are in the early stages of evolution and will change in scope and content as EPA and USFWS accumulate more experience. The AFO and GFO have completed three bioassessments (Table 4). Recently, the AFO has begun two bioassessments at Halby Chemical Company and Southern Maryland Treatment Plant, and GFO has proposed an IAG with EPA for bioassessment at Greenwood Chemical Company Site, Newton, Albemarle County, Virginia. Locations of all sites are shown in Figure 4.

Table 4. Superfund Site Bioassessment Studies.

Wildcat Landfill (1986-1988)
Chisman Creek (1986-1987)
L. A. Clarke (1986-1988)
Halby Chemical Company (1988-1989)
Southern Maryland Treating Plant (1989)
Greenwood Chemical Company Site (proposed)

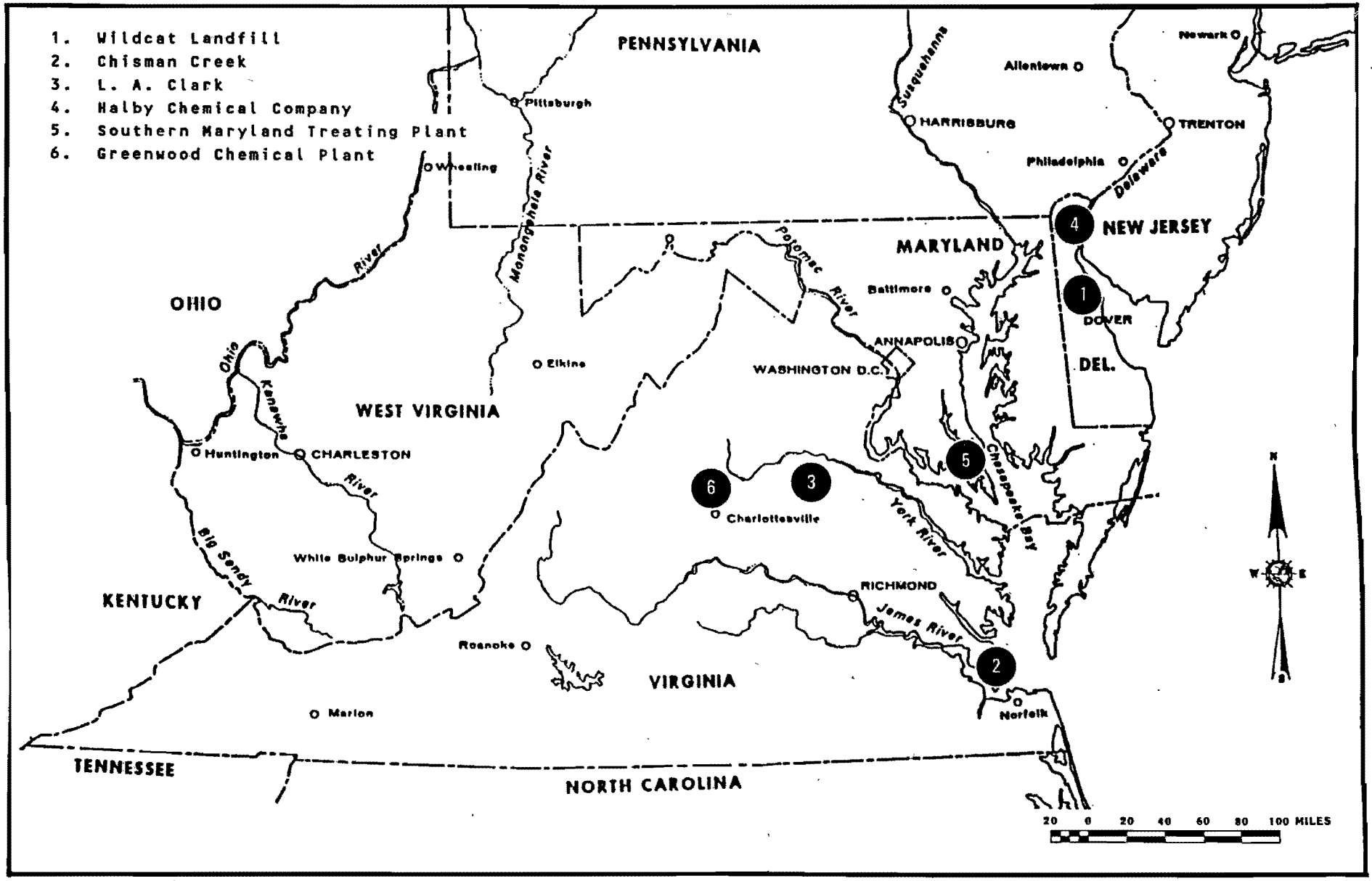

FIGURE 4. Locations of Superfund Site Bioassessment Studies conducted or currently proposed by AFO and GFO.

Project	:	**Wildcat Landfill Site**
Period of Study	:	1986-1988
Location	:	Wildcat Landfill, Dover, Kent County, Delaware
Contaminants of Concern	:	Barium, nickel, lead, and zinc
Species of Concern	:	Bald eagles, migratory waterbirds including shorebirds, waterfowl, terns, and gulls. Also, six state rare plants: barnyard grass (Echinochloa muricata), head bearing sedge (Carex cephalophora), crested false buckwheat (Polygonum scandens), Carolina crane's-bill (Geranium carolinianum), field pussytoes (Antennaria neglecta), and round-leaved boneset (Eupatorium rotundifolium).
Background Data	:	The Wildcat study was a pilot project which examined various methodologies for use in biological/environmental assessment of Superfund sites.
Types of Analysis and Species Analyzed	:	(1) Whole body chemical analysis of mummichogs (Fundulus heteroclitus) and white-footed mice. (2) Liver analysis of eastern painted turtles and snapping turtles. (3) Fillet analysis of channel catfish, white catfish, and white perch. (4) Chemical analysis of sediments (same sediments were used for bioassays). (5) Chemical analysis of water (same water was used for bioassays). (6) Acute bioassays with surface water from Wildcat pond and a reference pond. Test organisms were fathead minnows, Daphnia pulex, and Microtox bacteria. (7) Bioassays with sediment collected from St. Jones River, adjacent to the landfill. Acute 48 hour static renewal bioassays were run with sediments from 14 stations using fathead minnows and Daphnia magna. Chronic seven day

static renewal bioassays were run with sediments from 14 stations on the St. Jones River and a reference site using the fathead minnow and Ceriodaphnia dubia.

(8) Histopathological examination of mummichogs and white-footed mice collected from on-site and off-site locations.

(9) Enzyme assay of delta-aminolevulinic acid dehydratase (ALAD) in blood of eastern painted turtles from Wildcat Pond and a reference pond (for details on procedures refer to AFO-C89-2 publication).

Results : Whole body chemical analysis. For the white-footed mouse, there was no significant difference in concentrations of five of six metals analyzed between reference animals and those collected at the Wildcat site. However, there was a significant difference in mean cadmium concentration between reference and experimental site mice. The Wildcat mice were found to have 2.5 times more cadmium (0.05 ppm), but the level does not represent a health threat to mice. In general, mice from Wildcat were not bioaccumulating any metals.

Cadmium and nickel were not detected in the Wildcat mummichogs, and there was no significant difference in mercury concentrations between sites. The means for barium, lead, and zinc were significantly greater in Wildcat mummichogs. These elevated levels could induce stress in fish or contribute to biomagnification through the food chain.

Liver analysis of turtles. Barium, nickel, and lead were all significantly higher in Wildcat turtles than in the reference turtles. The lead concentration in a Wildcat snapping turtle liver was well above the reference value.

Fillet analysis of fish. Because of the many potential sources of contaminants in the St. Jones River watershed, the fish fillet data were not used to evaluate the effects of the Wildcat Landfill. However, two fish fillets (one white catfish and one channel catfish) did exceed FDA action levels for PCBs (2.0 ppm). The data was given to the Delaware Department of Natural Resources and Environmental Control for further investigation.

Chemical analysis of sediment/water. Water samples were collected from the Wildcat Pond and from leachate near the southwest corner of the pond. Cadmium, copper, iron, and zinc in the leachate sample exceeded EPA's acute water quality criteria. In addition, cadmium, copper, lead, vanadium, and zinc from the leachate sample were well above EPA's chronic criteria. Maximum observed concentrations of cadmium and iron in the pond exceeded acute criteria, and copper and vanadium exceeded chronic criteria. The leachate water was more toxic than the pond water and was also contributing to an enrichment of metals, an adverse effect.

Bioassays with surface water. Results from bioassay tests with fathead minnows, Daphnia magna, and Microtox bacteria indicated that contaminants from the northwest corner of the landfill may have leached into the pond in toxic concentrations.

Bioassays with sediment. Results from sediment bioassays indicated that contaminants from the Wildcat Landfill have not accumulated in the St. Jones River sediment to levels which caused acute or chronic toxicity.

Histopathological examination. Histological results did not show any consistent pattern of pathological changes in white-footed mice from the Wildcat Landfill compared to those from the reference site. Several lesions of the thyroid, including atrophy and sloughing of the follicular epithelium, were noted in many individuals. However, a detailed evaluation showed no evidence of an increased incidence of these lesions at the landfill. This suggests that contaminants from the landfill have not induced an increase in gross or histopathological lesions in white-footed mice.

Wildcat mummichogs had a significantly higher incidence of lesions (3.13 lesions per fish versus 1.73 at the reference site). On the basis of these results, Wildcat fish appeared to be less healthy than fish from the reference site. It is possible that the increased body burdens of barium, lead, and zinc documented through chemical analysis contributed to the increased lesions observed in Wildcat fish. Different environmental conditions such as dissolved oxygen and temperature may also have contributed to the condition of the fish at Wildcat.

ALAD enzyme assay. This test was performed to determine if high levels of lead known to occur in Wildcat Pond were inhibiting the activity of the ALAD enzyme. Depression of ALAD can impair hemoglobin synthesis resulting in a shortened life span of erythrocytes. ALAD can also impair detoxification processes in the liver and other tissues which could result in increased toxic contaminant burdens.

There was a significant difference in mean blood ALAD activity between the Wildcat turtles and the reference turtles. Mean ALAD activity was 30% lower in Wildcat turtles.

Reduced ALAD activity corresponded to significantly higher lead concentrations in Wildcat turtle livers, which is consistent with the scientific literature. Lower ALAD activity could reduce growth in Wildcat turtles and cause other lead-induced toxicity signs. The observed reduction of 81% of fat reserves in Wildcat turtles could increase overwintering mortality and reduce egg production. This evidence supports the conclusion that contaminants from Wildcat Landfill, especially lead, are negatively impacting eastern painted turtles in the Wildcat Pond.

Comments : The "Potentially Responsible Party" for Wildcat Landfill has agreed to fill in the contaminated Wildcat Pond and create a new pond off-site to provide mitigated habitat for fish and wildlife resources.

Project	:	**Chisman Creek Site**
Period of Study	:	1986-1987
Location	:	Chisman Creek, York County, Virginia
Contaminants of Concern	:	Metals (arsenic, cadmium, copper, lead, nickel, selenium, vanadium, and zinc).
Species of Concern	:	Migratory birds including waterfowl, shorebirds, colonial waterbirds, and passerine birds. Also, anadromous and other fish.
Background Data	:	The site consists of four abandoned sand and gravel borrow pits (ponds) that were filled with flyash from the Virginia Power Company Yorktown Power Generating Station. Elevated concentrations of trace metals were found in groundwater, surface water, soil, and sediment in and adjacent to the flyash disposal areas in 1980 and 1981. In 1983, the site was placed on EPA's National Priorities List. In 1986, at the request of EPA, GFO conducted a bioassessment study to evaluate the impacts of contaminants at the site on fish and wildlife resources and their habitats.
Type(s) of Analysis and Species Analyzed	:	(1) Whole body chemical analysis of mosquitofish (Gambusia affinis), fingerling bluegill, and largemouth bass. (2) Fillet and carcass chemical analysis of adult bluegill and largemouth bass. (3) Chemical analysis of water. (4) Chemical analysis of sediment. (5) Chemical analysis of aquatic vegetation. (6) Chemical analysis of American oyster (Crassostrea virginica). (7) Freshwater bioassays with water collected from three ponds and a tributary on-site and a reference pond and tributary off-site. Species used were Ceriodaphnia dubia and fathead minnows.

(8) Saltwater bioassays with water collected from four sites in Chisman Creek and two reference sites in Bennett Creek. Test organisms included sea urchin sperm cell test, reproductive test using a red marine macroalga (Champia parvula), and the Microtox test using a marine bacterium (Photobacterium phosphoreum).

(9) Sediment bioassays using grass shrimp (Palaemonetes pugio) and blue mussels (Mytilus edulis) with sediment collected at two sites in Chisman Creek and two sites in Bennett Creek.

(10) Histopathological examination of channel catfish, bluegill, largemouth bass, and oysters.

(11) Qualitative and quantitative survey of the benthic macrofauna.

(12) Qualitative field survey of Chisman Creek and adjacent areas to identify the flora and fauna on-site.

Results : Whole body, fillet, and carcass chemical analysis of fish. In general, vanadium, nickel, and selenium were found at higher concentrations than other metals, regardless of species. The highest concentrations of most metals were found at one of the on-site ponds (Pond 1). Metal concentrations were typically higher in bluegill than in largemouth bass. Concentrations of metals in fillets from on-site ponds were similar to concentrations from the reference pond.

Chemical analysis of water. The on-site freshwater tributary and one of the on-site ponds (Pond 1) had elevated vanadium concentrations compared to the respective reference site.

Concentrations of nickel and cadmium in Chisman Creek (saltwater) were elevated upstream towards the site. Lead, copper, selenium, and zinc were also present in water samples near the site while no lead, copper, selenium, vanadium, or nickel was detected in samples collected from Bennett Creek (reference site).

Chemical analysis of sediment. The on-site freshwater tributary had a higher vanadium concentration than reference sediment. Elevated

levels of nickel, vanadium, and zinc were found in Pond 1 sediments on-site, and elevated levels of arsenic and selenium were found in Pond 2 sediments on-site.

The highest levels of nickel, vanadium, and zinc were found in Chisman Creek near its headwaters. The highest concentrations of metals were at a depth of two to six inches. Concentrations of nickel, lead, and vanadium were lower in Bennett Creek than Chisman Creek with no obvious location trends.

Chemical analysis of aquatic vegetation. Metals were found to have bioaccumulated in aquatic freshwater plants and reflected concentrations of metals found in sediment samples of respective ponds.

Chemical analysis of oysters. There was no one trend that was consistent for all of the metals analyzed. Concentrations of metals in oysters from Bennett Creek were similar to those in oysters from Chisman Creek except for vanadium. The concentration of vanadium in oysters from Chisman Creek averaged 0.20 ppm and averaged 0.11 ppm for Bennett Creek oysters.

Freshwater bioassay. Toxicity tests were performed using surface water to measure the effect on the survival and growth of fathead minnows and survival and reproduction of Ceriodaphnia dubia. Water collected from Pond 1 was found to be chronically toxic to the Ceriodaphnia. The freshwater tributary on-site was found to be acutely toxic to Ceriodaphnia. While survival of fathead minnows in water from Pond 1 was good, growth was somewhat less than in the other three ponds (two experimental, one reference). However, growth was not statistically less and was well within the normal range for fathead minnows.

Saltwater bioassay. The sea urchin sperm cell toxicity tests showed only slight toxicity at Chisman Creek. In general, the two-day Champia parvula reproductive tests of samples from Chisman and Bennett Creek were not statistically different in their response.

Sediment bioassay. None of the blue mussels died during the experiments, and low mortality rates were observed among grass shrimp. There were no

significant differences between the mortalities of grass shrimp exposed to sediment from the sites. The mean respiration rate of shrimp exposed to sediments from one of the Chisman Creek sites was 37% lower than that of the Bennett Creek reference sites.

Histopathological examination. Histological evaluations revealed lesions in the meninges, brain, gills, heart, liver, intestines, stomach, mesentery, and skin of some of the fish collected. The majority of the lesions were of presumptive parasitic origin. There was no significant difference in the number of lesions of fish from different ponds.

The general health of the oysters from each of the creeks was similar, as observed by gross macroscopic examination.

Benthic macrofauna. There were no major differences found in species composition of benthic macrofauna between Chisman Creek and Bennett Creek.

Comments : A final report of GFO's findings has been sent to EPA. This extensive project involved the assistance and cooperation of EPA, University of Maryland, National Marine Fisheries Service, Old Dominion University, Rocky Mountain Analytical Laboratory, JTC Environmental Consultants, Chemtech, and Versar, Inc.

Project:	:	**L. A. Clarke Site**
Period of Study	:	1986-1987
Location	:	L. A. Clarke, Fredericksburg, Spotsylvania County, Virginia
Contaminants of Concern	:	PAHs
Species of Concern	:	Colonial waterbirds, migratory waterfowl, bald eagles, ospreys, and anadromous fish.
Background Data	:	In 1986, as part of the remedial investigation at the site, GFO conducted biological studies to assess the effects of contaminants from the L. A. Clarke site on fish and wildlife resources.
Type(s) of Analysis and Species Analyzed	:	(1) Whole body chemical analysis of bluegill and gizzard shad. (2) Bioassays using surface water collected from three on-site locations and one reference site. The species used for survival and growth testing were fathead minnows, Ceriodaphinia dubia, and Microtox bacteria. (3) Bioassays using sediment collected from two on-site locations and one reference site. The test organisms used were fathead minnows and bivalve mollusks (Rangia spp.). (4) Histopathological examination of bluegill, white sucker, fallfish, and brown bullhead collected from an on-site pond, downstream site, and an upstream reference site. (5) Field survey of fish and wildlife species at L. A. Clarke. (6) Qualitative benthic survey.
Results	:	Whole body and fillet chemical analysis. All whole body and fillet samples had concentrations of less than 100 to 300 ppb of individual PAH compounds. Bioassays using surface water. Surface water samples from the upstream reference area were not acutely or chronically toxic to fathead minnows,

Ceriodaphnia dubia, or Microtox bacteria. Surface water samples collected from sources impacted by the site were acutely toxic to fathead minnows and produced a chronic effect on Ceriodaphnia. One station also showed a significant reduction in light output of the Microtox bacteria.

Bioassays using sediments. There were no acute lethal effects associated with the exposure of fathead minnows and Rangia to sediments from any of the sampling sites. However, sublethal effects of toxicity were found with on-site sediment. These effects included increased respiration of Rangia and reduction in the osmoregulation capacity of fathead minnows.

Histopathological examination. Lesions of parasitic origin comprised 76%, 80%, and 29% of all lesions observed in the upstream reference, downstream, and the on-site pond sites, respectively. In fish examined from the stream, lesions not associated with parasites were few in number, nonspecific in nature, and did not appear to affect the function of organs. The pond had a high incidence of fish with lesions not associated with parasites.

Qualitative benthic survey. The number of families found in the reference area was similar to the number of families in other sampling areas.

Summary. The results of this study indicate that localized problem areas exist on or in close proximity to the L. A. Clarke site.

Comments : Remedial clean-up by the responsible party is underway.

Project	:	**Halby Chemical Company Site**
Period of Study	:	1988-1989
Location	:	Halby Chemical Company Site, New Castle, New Castle County, Delaware
Contaminants of Concern	:	Organic and inorganic compounds
Species of Concern	:	Waterfowl, colonial waterbirds, and anadromous and other fish.
Background Data	:	Sulfur compounds were produced at the site from 1948 to 1977. Samples collected in 1984 by EPA indicated that an on-site lagoon was contaminated with organic and inorganic compounds including aluminum, arsenic, cadmium, chromium, copper, zinc, lead, mercury, ammonium thiocyanate, carbon disulfide, iso-octyl-alcohol, naphthalene, and chrysene. Groundwater underlying the site was contaminated with thiocyanate, arsenic and mercury. Levels of heavy metals and PAHs in water and sediment samples from the lagoon outfall indicated that contaminants were migrating from the site.
Type(s) of Analysis and Species Analyzed	:	(1) Whole body chemical analysis of mummichogs and blue crabs. (2) Qualitative and quantitative benthic survey. (3) Bioassay using surface water (test species have yet to be determined). (4) Bioassay using sediment (test species have yet to be determined).
Results	:	Samples for this study will be collected during spring-summer 1989.

Preliminary Natural Resource Surveys (PNRS)

Preliminary Natural Resource Surveys are conducted at sites or incidences of oil discharge and hazardous substances release to determine whether damages have occurred to natural resources. The principal facts gathered are whether any resources are present in the vicinity of the incident or site and whether there are any damages to them due to hazardous substances. Through the authority of a Memorandum of Understanding, EPA can request and fund some PNRSs to be conducted by U.S. Department of Interior, USFWS. Federal and State governments, as trustees for natural resources, may bring claims against responsible parties for any damages to these resources caused by the release of hazardous substances under the authority of Sections 107 and 111 of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA, also known as the Superfund Act); Section 311 of the Clean Water Act; and Executive Order 12316, Subpart G of the National Oil and Hazardous Substance Contingency Plan. Since 1983, the AFO and GFO have conducted 44 PNRSs. Table 5 lists all PNRSs completed by the two field offices. Locations of these sites are shown in Figures 5-8. For more information on any of these sites contact the AFO, GFO, or EPA.

Table 5. Preliminary Natural Resource Surveys.

Delaware

Army Creek Landfill Site, New Castle, New Castle County (AFO)
Chem-Solv., Inc., Cheswold, Kent County (AFO)
New Castle Spill Site, New Castle, New Castle County (AFO)
Tybouts Corner Landfill Site, Wilmington, New Castle County (AFO)
NCR Site, Millsboro, Sussex County (AFO)
Halby Chemical Company, New Castle County (AFO)
Delaware City PVC Site, Delaware City, New Castle County (AFO)
Delaware Sand and Gravel Landfill Site, New Castle, New Castle County (AFO)
Pigeon Point Landfill Site, New Castle, New Castle County (AFO)
Cokers Sanitation Service Landfills Site, Cheswold, Kent County (AFO)
Harvey and Knott Drum, Inc. Site, Kirkwood, New Castle County (AFO)
Old Brine Sludge Landfill, Delaware City, New Castle County (AFO)
Dover Gas Light Company Site, Dover, Kent County (AFO)
Sealand Site, Mount Pleasant, New Castle County (AFO)
Tyler Refrigerator Pit, Smyrna, Kent County (AFO)
Dupont-Newport Site, New Castle, New Castle County (AFO)

Table 5 (cont.). Preliminary Natural Resource Surveys.

Maryland

Southern Maryland Wood Treating Site, Hollywood, St. Mary's County (AFO)
Limestone Road Site, Cumberland, Allegheny County (AFO)
Sand, Gravel, and Stone Site, Elkton, Cecil County (AFO)
Mid-Atlantic Wood Preservers, Inc. Site, Harmans, Anne Arundel County (AFO)
Woodlawn County Landfill Site, Woodlawn, Cecil County (AFO)
Aberdeen Proving Ground - Michaelsville Landfill Site, Aberdeen, Hartford County (AFO)
Kane and Lombard Street Drums Site, City of Baltimore (AFO)
Aberdeen Proving Grounds - Edgewood Area Site, Edgewood, Harford County (AFO)

Virginia

Atlantic Wood Industries, Inc., City of Portsmouth (GFO)
C and R Battery Company, Inc., Chesterfield, Chesterfield County (GFO)
Chisman Creek Site, York County (GFO)
Culpeper Wood Preservers, Inc., Culpeper, Culpeper County (GFO)
IBM Corporation Manassas Plant Spill Site, Manassas, Prince William County (GFO)
Saunders Supply Company, Chuckatuck, Suffolk, Norfolk County (AFO)
U.S. Titanium Site, Piney River, Nelson County (AFO)
Greenwood Chemical Company Site, Newton, Albemarle County (AFO)
Buckingham County Landfill, Buckingham, Buckingham County (GFO)
H and H, Inc. Burn Pit Site, Farrington, Hanover County (AFO)
Defense General Supply Center, Chesterfield, Chesterfield County (AFO)
Rentokil, Inc. (Virginia Wood Preserving Division) Site, City of Richmond (GFO)
Rhinehart Tire Fire Dump Site, Mount Pleasant, Frederick County, Virginia (GFO)
Matthews Electroplating Site, Dixie Caverns, Roanoke County (GFO)
Avtex Fibers, Inc., Front Royal, Warren County (GFO)
L. A. Clarke Site, Fredericksburg, Spotsylvania County (GFO)
Saltville Waste Disposal Site, Saltville, Smyth County (GFO)
Dixie Caverns County Landfill, Dixie Caverns, Roanoke County (AFO)
First Piedmont Rock Quarry, Danville, Pittsylvania County (AFO)

West Virginia

West Virginia Ordnance Site, Point Pleasant, Mason County (AFO)

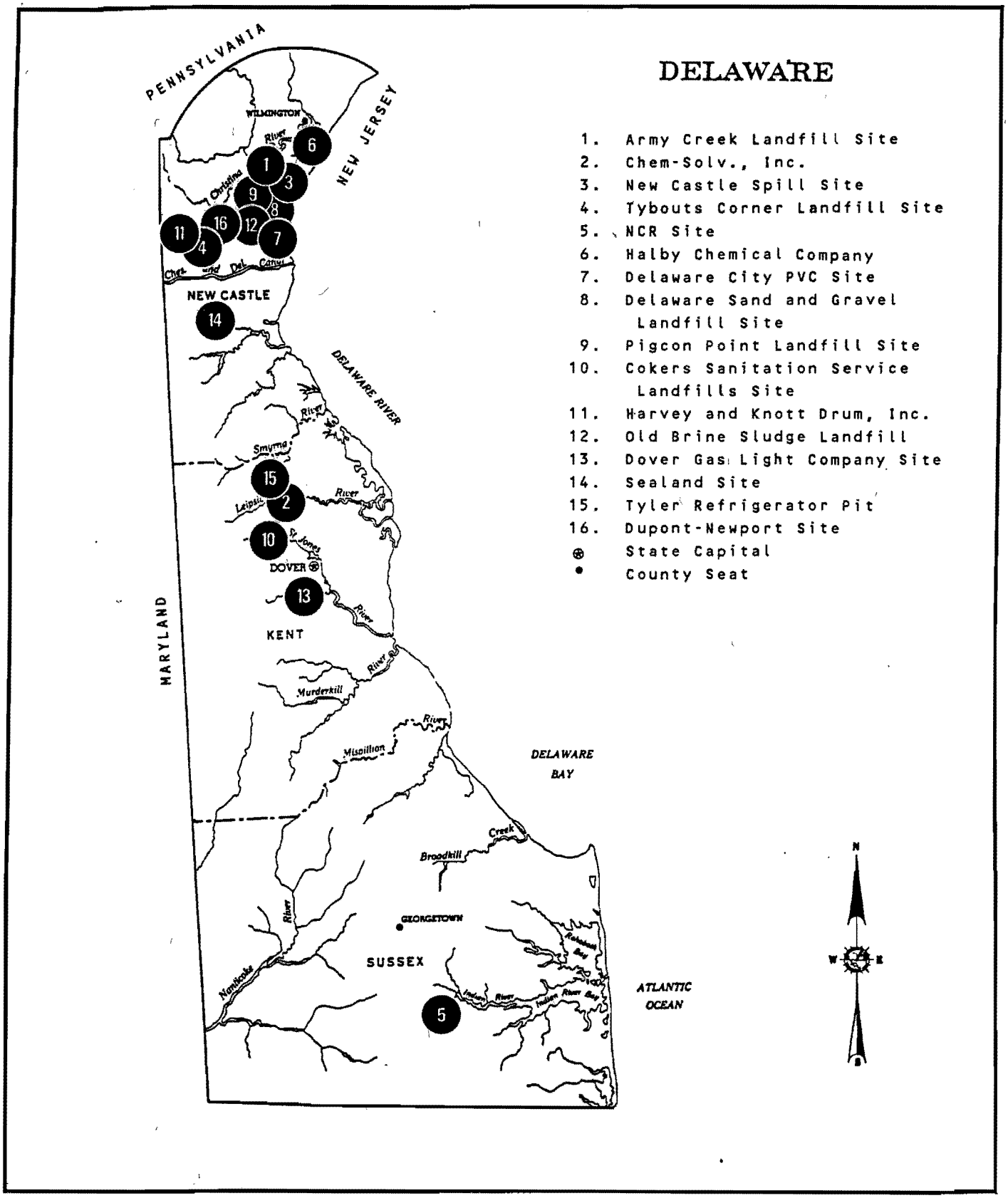

FIGURE 5. Delaware locations of Preliminary Natural Resource Surveys conducted by AFO and GFO.

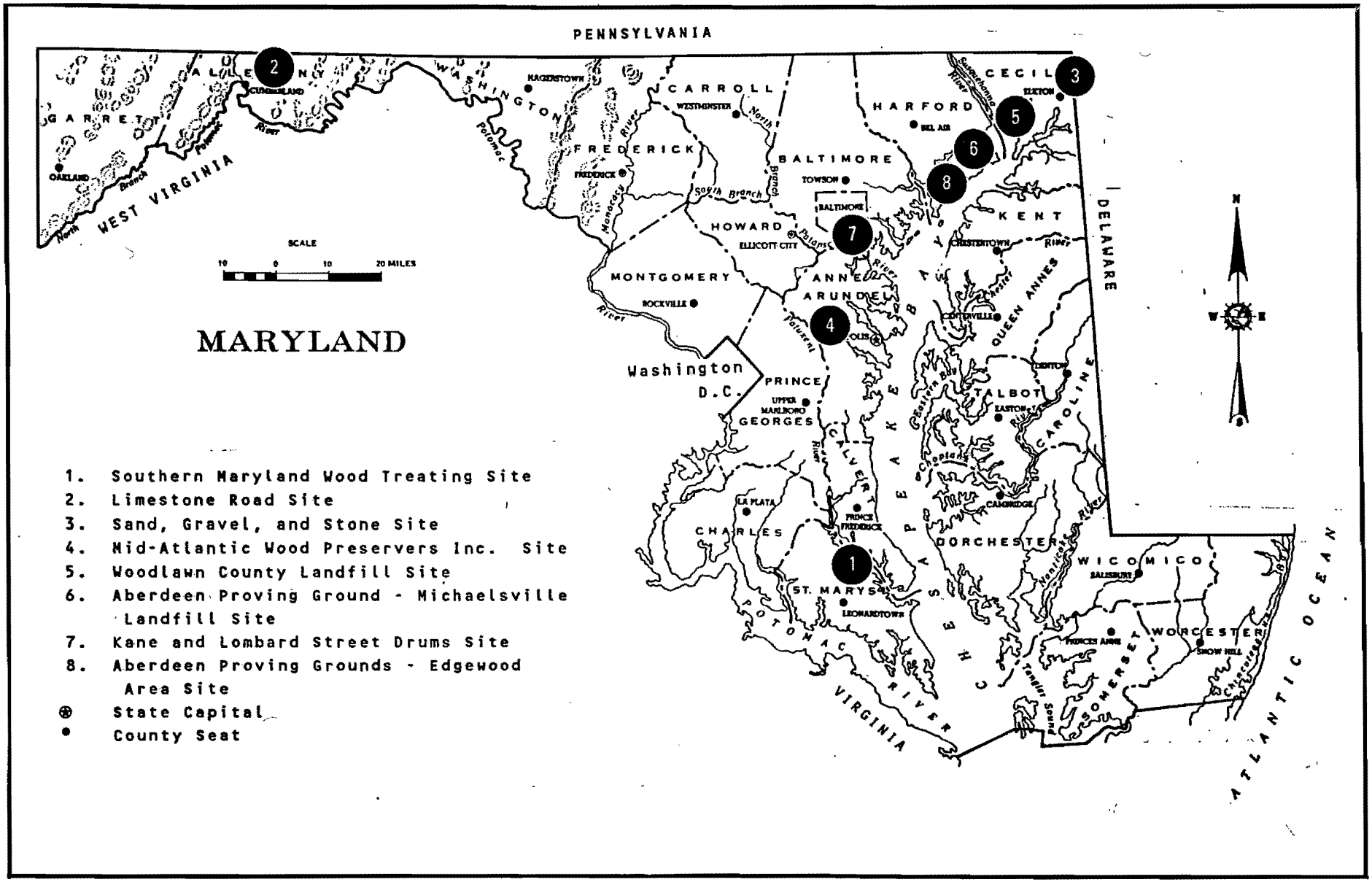

FIGURE 6. Maryland locations of Preliminary Natural Resource Surveys conducted by AFO and GFO.

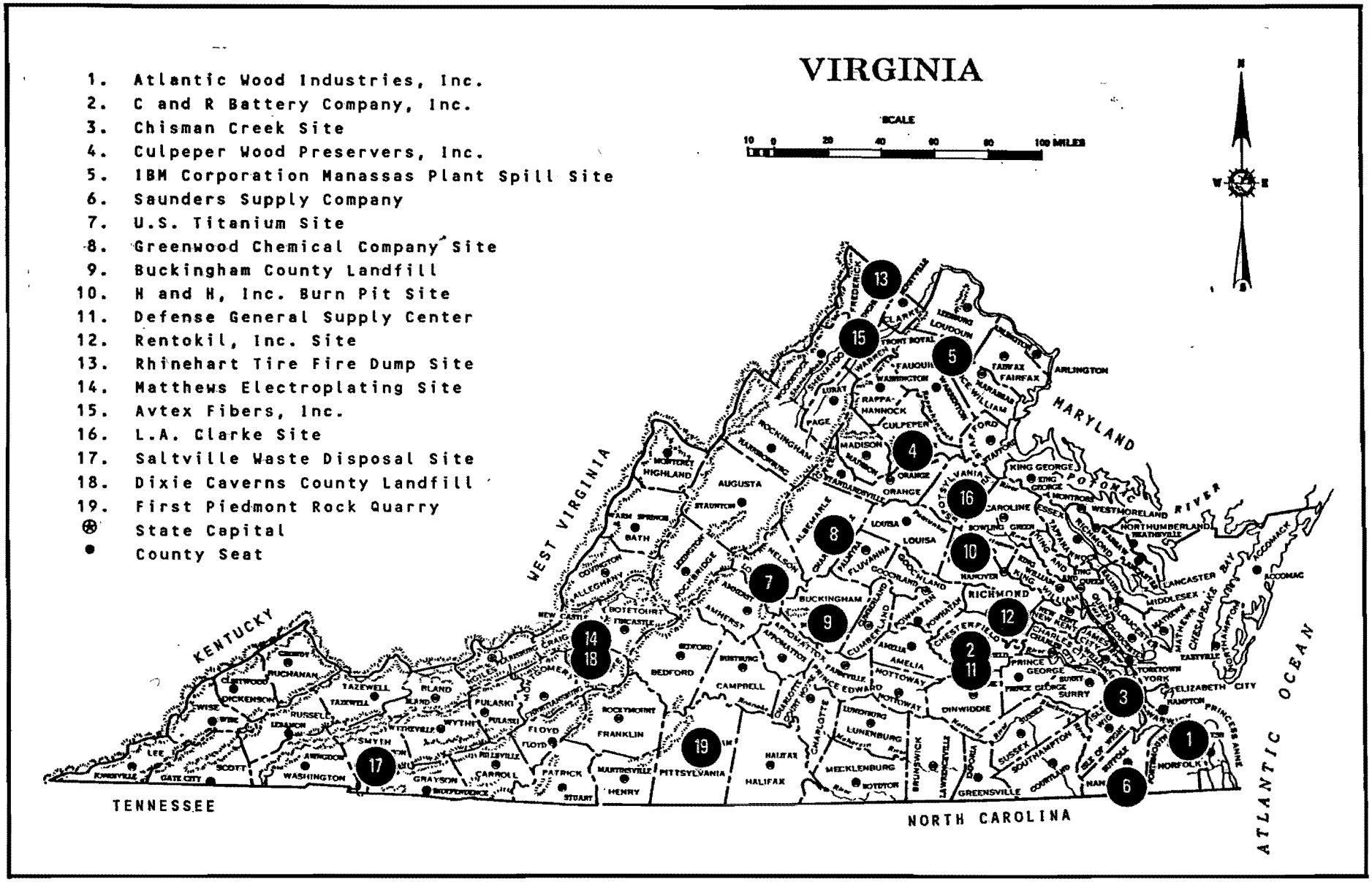

FIGURE 7. Virginia locations of Preliminary Natural Resource Surveys conducted by AFO and GFO.

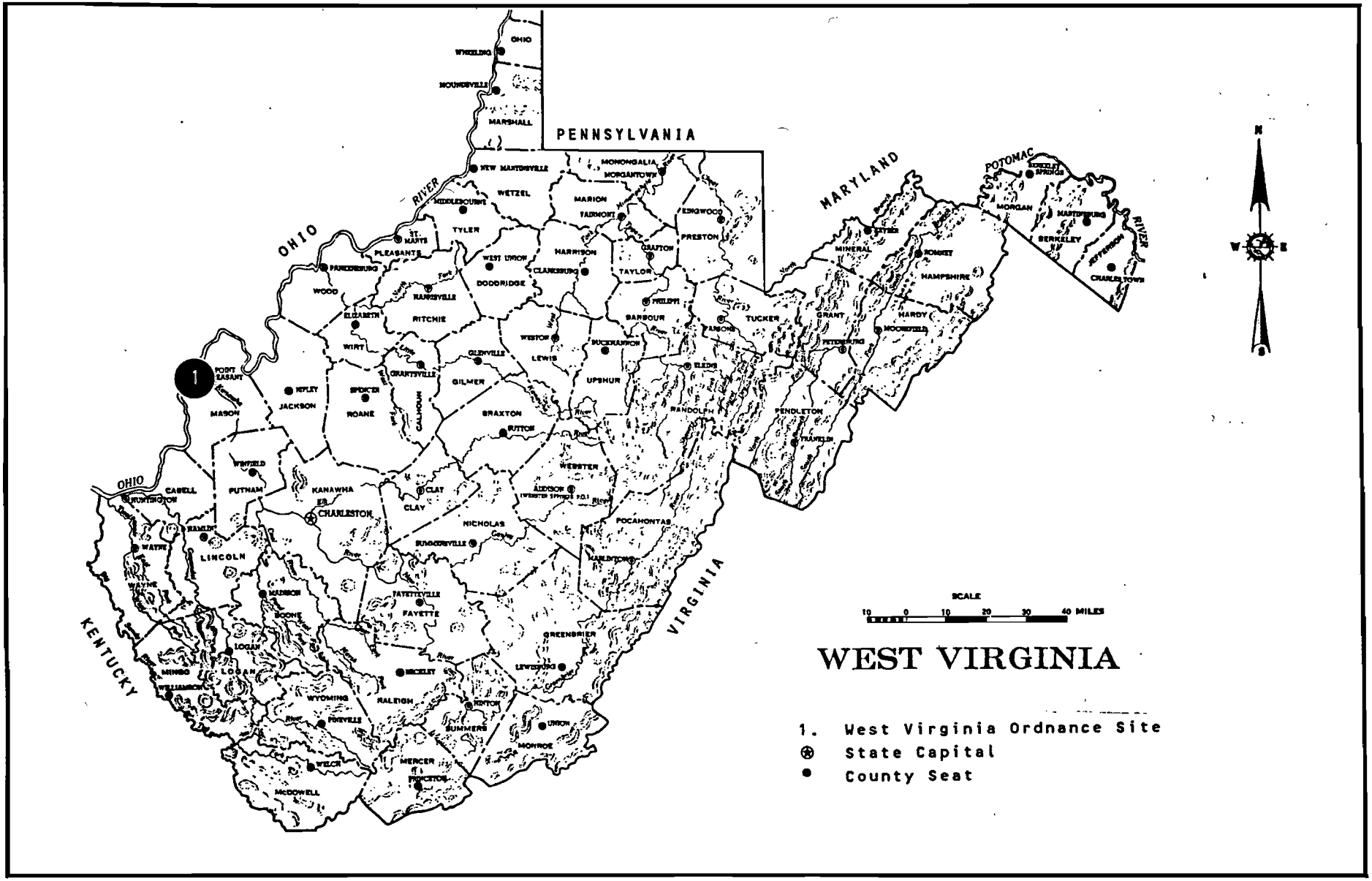

FIGURE 8. West Virginia locations of Preliminary Natural Resource Surveys conducted by AFO and GFO.

Special Studies

Studies included in this section are projects which received outside funding (e.g., Department of the Navy, Chesapeake Bay Foundation, etc.) emergency funding, or involved a cooperative agreement set up through the field offices and/or regional office. These studies are listed in Table 6. Locations of these studies are shown in Figure 9.

Table 6. Special Studies.

Accotink Creek Histopathology Study (1985-1986)
Indian Head Naval Ordnance Station Contaminant Study (1986-1988)
James River Non-Standard Chemical Analysis Study (1988)
Carbofuran Poisoning of Eagles Study (1988)
Chester River Histopathology Study (1988-1989)

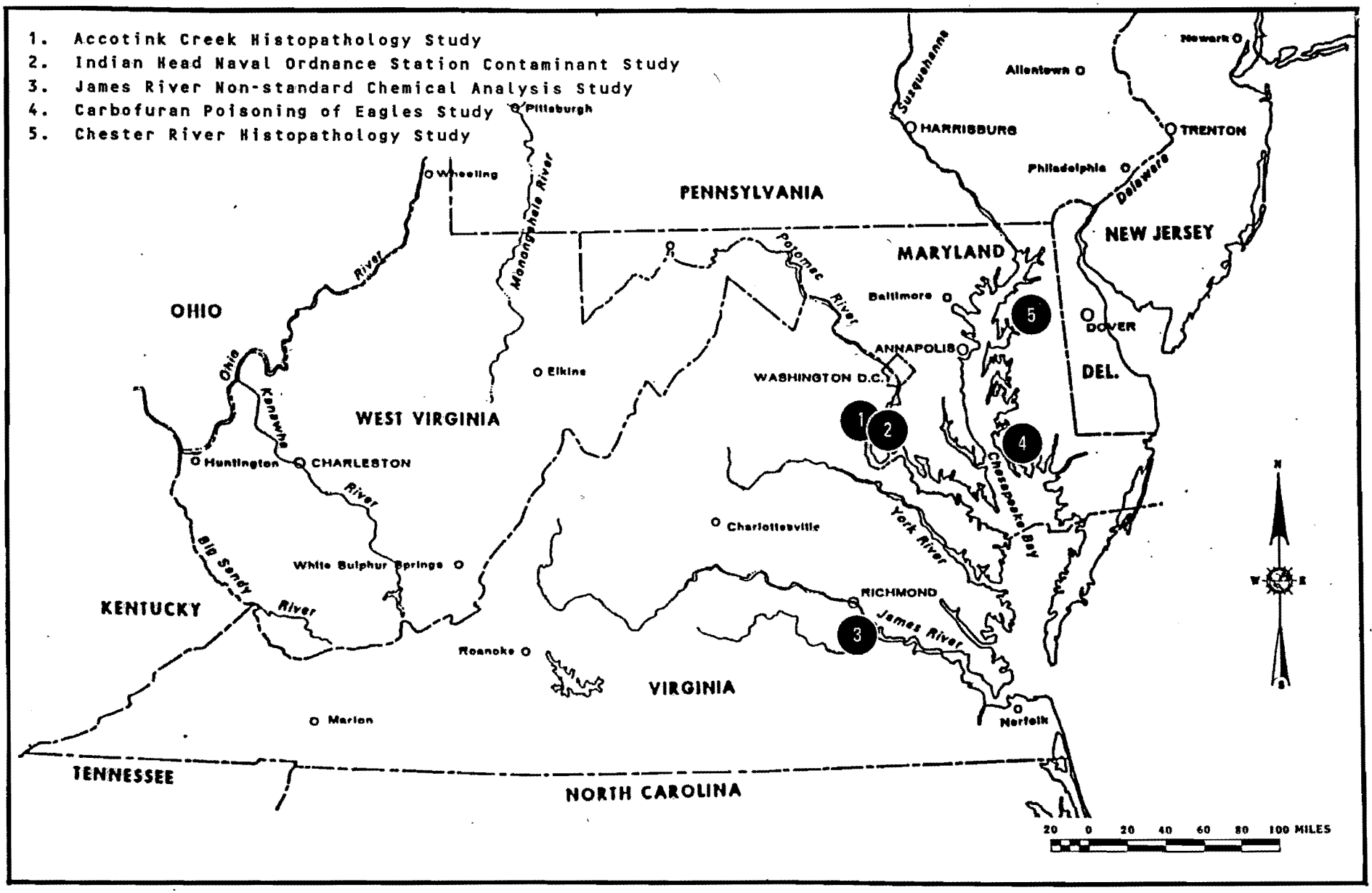

FIGURE 9. Locations of Special Studies conducted by AFO and GFO.

Project	:	**Accotink Creek Histopathology Study**
Period of Study	:	1985-1986
Location	:	Accotink Creek near Gunston Cove, tributary of the Potomac River, Woodbridge, Fairfax County, Virginia, near Mason Neck NWR
Contaminants of Concern	:	Organochlorines and heavy metals suspected
Species of Concern	:	All anadromous and other fish
Background Data	:	Brown bullheads caught in Accotink Creek reportedly had numerous external lesions. The AFO responded to these reports by conducting a preliminary histopathology study to determine the health status of fish in Accotink Creek.
Type(s) of Analysis and Species Analyzed	:	Histopathological examination of brown bullheads.
Results	:	Lesion incidence (> 50%) seen in brown bullheads of Accotink Creek was higher than expected based on comparison with fish collected from a reference site (Monie Creek, Somerset County, Maryland). Incidence rates approached that of a highly impacted ecosystem. The lesions were suggestive of a toxicant that affects lipid-rich organs such as nerves and livers. Kidneys were affected, which is compatible with an organic toxicant, but not specific to it.
Comments	:	Contaminants present in fish and sediment needed to be identified. Chemical analysis was planned as part of the 1987 Mason Neck NWR Contaminant Study. Analysis of this chemical data is currently underway.

Project	:	**Indian Head Naval Ordnance Station (NOS) Contaminant Study**
Period of Study	:	1986-1988
Location	:	Mattawoman Creek, tributary of the Potomac River, Charles County, Maryland
Contaminants of Concern	:	Mercury and possibly other metals.
Species of Concern	:	All anadromous and other fish.
Background Data	:	This study developed as a follow-up to the Indian Head NOS NPDES study. The purpose of the study was to monitor fish health through chemical analysis of whole body samples. Information was used to determine if mercury and other metals from Indian Head NOS were bioaccumulating in fish.
Type(s) of Analysis and Species Analyzed	:	(1) Whole body chemical analysis of largemouth bass, channel catfish, and bluegill. (2) Chemical analysis of sediment.
Results	:	Total mercury concentrations in largemouth bass, channel catfish, and bluegill in the vicinity of NOS (Marsh Island) were not significantly higher than those found at an upstream reference site. Mercury levels were below National Contaminant Biomonitoring Program means. All species of fish had higher mean mercury concentration in the spring (June and July) versus fall (September and October). However, the only significant difference between seasons was shown in largemouth bass where mean concentration was 2.5 times higher in spring samples. A possible explanation of this observation is that fish during spring are increasing in weight for gonad maturation; therefore, an increased mercury ingestion through food can be expected. After spawning, in the fall, fish will have eliminated eggs and sperm, reducing part of the mercury burden.

Largemouth bass had the highest mean mercury concentration, more than two times higher than channel catfish and almost three times higher than bluegill. The relationship shows mercury concentrations in Mattawoman Creek fish were positively associated with trophic level and size of species.

Comments : A final report of this study has been prepared (AFO-C88-3).

Project	:	**James River Non-Standard Chemical Analysis Study**
Period of Study	:	1988
Location	:	James River, near Hopewell, Prince George County, Virginia
Contaminants of Concern	:	Kepone, octahydrodibenzothiophene-1-one, dehydroabietane, dibenzothiophene, 2 cyclohexyl-cyclohexanone, diterpenoid
Species of Concern	:	Bald eagles, wintering waterfowl, all anadromous and other fish
Background Data	:	With Presquile NWR just upstream and the new USFWS acquisition of the bald eagle roost property just downstream, it is important to have as much data as possible on contaminants in the James River. Current data is needed on the contaminant loading of eagle prey. This study, combined with the James River Eagle Prey and Presquile NWR Contaminant Studies, covered approximately 18 nautical miles of continuous river.
Type(s) of Analysis and Species Analyzed	:	Whole body chemical analysis of gizzard shad, channel catfish, and white catfish.
Results	:	Awaiting laboratory results.
Comments	:	This study was funded by the Chesapeake Bay Foundation, and analysis will be conducted by the Virginia Institute of Marine Science.

Project	:	**Carbofuran Poisoning of Eagles Study**
Period of Study	:	1988
Location	:	Area near Blackwater NWR, Dorchester County, Maryland
Contaminants of Concern	:	Carbamates (mainly carbofuran) and organophosphates
Species of Concern	:	Bald and golden eagles and all other protected species of birds utilizing the study area
Background Data	:	In the spring of 1988, the USFWS determined carbofuran to be the causative agent in the deaths of two eagles in Dorchester County, Maryland. It was strongly suspected that carbofuran poisoning was responsible for several other deaths near Blackwater NWR in Dorchester County. Blackwater NWR has a well known winter eagle roost. Several eagles also nest there in the spring. In general, carbofuran is used to control insects, but it is also used illegally to control "pest" mammals, such as raccoons (Procyon lotor), from damaging corn crops in Maryland.
Type(s) of Analysis and Species Analyzed	:	Chemical analysis of 10 individual birds and one mammal found dead in Dorchester County, Maryland. Only the upper gastrointestinal tract and contents were analyzed. The species of birds were bald eagle, golden eagle (Aquila chrysaetos), least sandpiper (Calidris minutilla), semipalmated sandpiper (Calidris pusilla), semipalmated plover (Charadrius semipalmatus), and brown-headed cowbird (Molothrus ater). The mammal was a raccoon.
Results	:	Of the 11 animals collected and analyzed, two of three bald eagles, two of two golden eagles, one of two cowbirds, a raccoon, a least sandpiper, and a semipalmated plover contained carbofuran. Levels of carbofuran were as high as 1,325 ppm. There were no other carbamates or organophosphates found in any of the samples.
Comments	:	Prior to this study, USFWS provided EPA with a biological opinion discussing adverse effects of carbofuran on endangered and threatened species. The opinion suggested prohibition of sale and use

of granular carbofuran in portions of Maryland, Delaware, and Virginia to protect bald eagles. The results of this study were sent to EPA in hopes of immediate action to:

(1) Prohibit the sale and use of granular carbofuran in important eagle nesting areas.

(2) Investigate possible violations of the Federal Insecticide, Fungicide, and Rodenticide Act by illegal use of carbofuran to poison raccoons.

(3) Complete the EPA special review of carbofuran.

Samples for this study were collected by USFWS Law Enforcement in Cambridge, Maryland, and the Maryland Department of Agriculture; other cooperators in this study were Maryland Department of Natural Resources, USFWS Annapolis Field Office, and USFWS Region 5 office.

Project	:	**Chester River Histopathology Study**
Period of Study	:	1988-1989
Location	:	Chester River, Kent and Queen Anne Counties, Maryland
Contaminants of Concern	:	Unknown
Species of Concern	:	All anadromous and other fish
Background Data	:	Leachate from a municipal landfill was suspected of causing lesions found on a number of brown bullhead over the past few years. Little is known about types and/or extent of lesions found on these bullhead.
Type(s) of Analysis and Species Analyzed	:	Histopathological examination of brown bullhead.
Results	:	Study not completed.

Oil Spill Studies

As specified in the National Contingency Plan, the USFWS is responsible for determining potential impacts of oil spills to migratory birds (mainly waterfowl) and anadromous fish. Typically, when an oil spill occurs, the State or U.S. Coast Guard will contact USFWS when natural resources are suspected to be at risk. Most spills handled by the AFO/GFO have been of small quantities and of little danger to natural resources. However, cumulative impacts of these many minor spills have yet to be investigated. When a major spill occurs and natural resources are at risk, a damage assessment is conducted. There are two types of damage assessments. The Type A Damage Assessment is performed on spills occurring in coastal waters; while a Type B Damage Assessment relates to inland, freshwater, and terrestrial spills. Most minor spills occur near major ports such as Baltimore and Norfolk. The two major oil spills which the AFO was involved with occurred on the Chesapeake Bay and the Ohio River. They are summarized on the following pages.

Project	:	**Ohio River Oil Spill**
Period of Study	:	1988
Location	:	Ohio River from south of Wheeling, Ohio County, West Virginia to St. Mary's, Pleasant County, West Virginia.
Contaminants of Concern	:	Diesel fuel No. 2
Species of Concern	:	Migratory waterfowl and freshwater fish.
Background Data	:	On January 2, 1988, an Ashland Oil Company fuel storage tank collapsed adjacent to the Monongahela River near Pittsburgh, Pennsylvania. When the spill continued to move down to the Ohio River into West Virginia state waters, the USFWS's Elkins and Annapolis Field Offices assisted in assessment of the oil spill and its impact to fisheries of the Ohio River.
Type(s) of Analysis and Species Analyzed	:	Otter trawling of the river bottom for dead fish to assess total impact of oil spill on fisheries. This coincided with shoreline and lock fish counts.
Results	:	The majority of the fish found on the river bottom were gizzard shad. Other fish found were largemouth bass, crappie, bluegill, freshwater drum (Aplodinotus grunniens), channel catfish, flathead catfish (Pylodictis olivaris), and other common freshwater fish.
Comments	:	Data collected by USFWS, West Virginia DNR, and EPA was combined and used in an American Fisheries Society oil spill model to calculate a monetary value for damages to the State of West Virginia fisheries. Ashland Oil Company admitted responsibility for the spill and was billed for damages.

Project	:	**Chesapeake Bay Oil Spill**
Period of Study	:	1988
Location	:	Mouth of Potomac River east across to Smith Island and about five miles south
Contaminants of Concern	:	Diesel fuel No. 2, gasoline
Species of Concern	:	Migratory birds, all anadromous and other fish, oysters, crabs, and wetland habitat
Background Data	:	On August 24, 1988, a 240-foot fuel barge ruptured while being towed out of Chesapeake Bay. It was estimated that close to 200,000 gallons of fuel were spilled. Most of the fuel emulsified into the water column or evaporated and could not be recovered by the U.S. Coast Guard. Environmental impacts were expected to be minimal since most migratory waterfowl had not yet arrived in the Chesapeake Bay.
Type(s) of Analysis and Species Analyzed	:	For Type A Damage Assessment, the AFO used computer modelling programs with corresponding field work to determine environmental impacts of the oil spill. This is a relatively new, quick, and inexpensive method of environmental assessment.
Results	:	The completed damage assessment was submitted to the State of Maryland for enforcement action.

National Contaminant Biomonitoring Program (NCBP)

The National Pesticide Monitoring Program was started in 1964 to monitor organochlorine pesticides. In recent years, the program has been expanded to include metals and industrial chemicals, as well as several more pesticides. With the expansion of chemical analysis, the name of the program was changed. The purpose of the biomonitoring program is to determine how levels of contaminants in fish and wildlife vary by geographic region and over time. Collections are made every two years as part of the NCBP's goal to determine national trends of contaminants in fish.

As part of the USFWS's NCBP, the AFO and GFO are responsible for collecting fish from the Susquehanna, James, and Potomac Rivers to be analyzed for metal and organic compound contamination. The USFWS's Fisheries Assistance staff has taken the lead in collecting fish from the James and Potomac Rivers. Also in 1986, the AFO assisted the USFWS's Elkins Office in collecting fish from the Kanawha River, West Virginia. Figure 10 shows locations of collection sites.

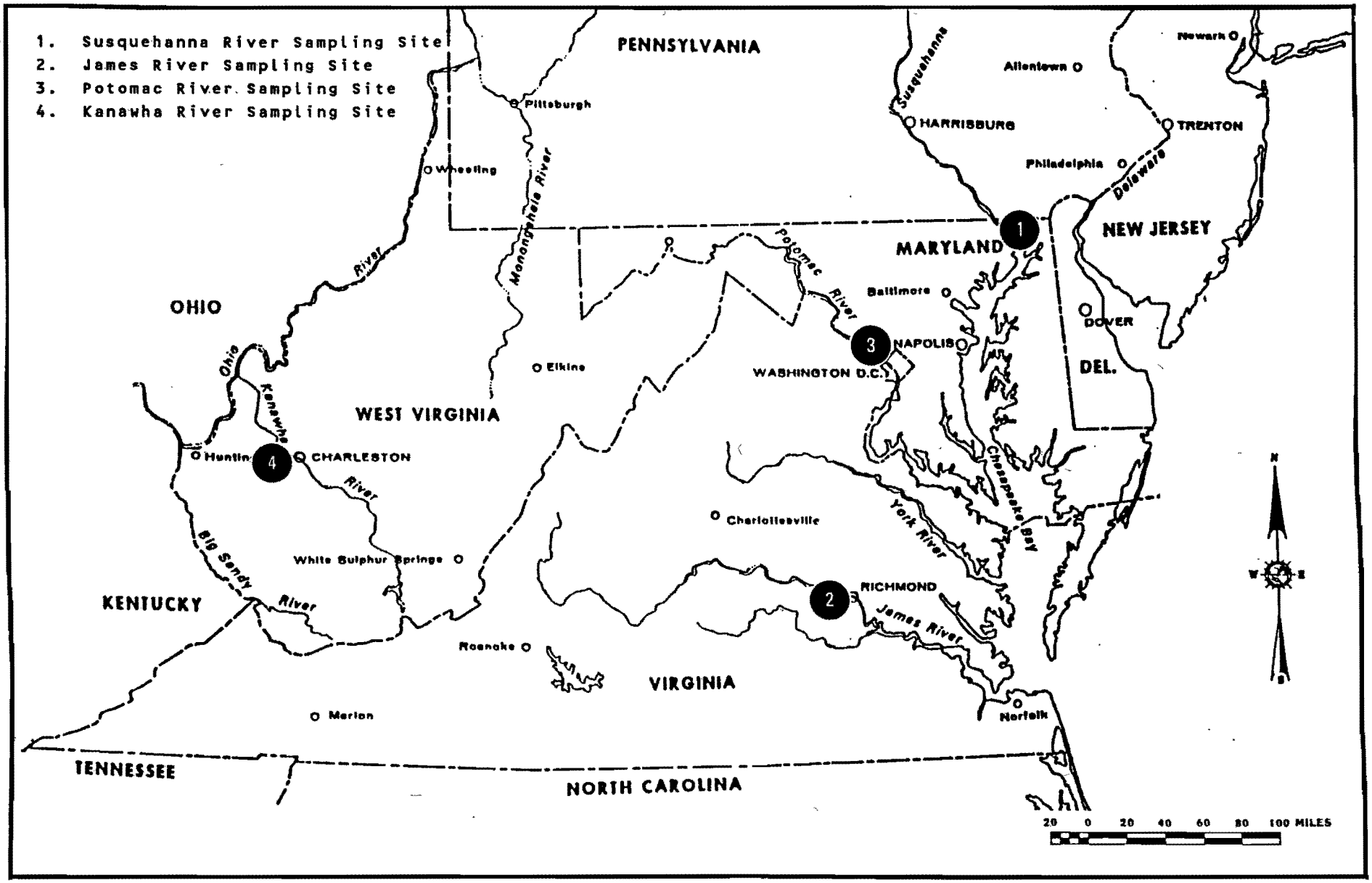

FIGURE 10. Locations of sites sampled every two years for the National Contaminant Biomonitoring Program by AFO and GFO (Susquehanna, James, and Potomac Rivers) and USFWS Elkins Office (Kanawha River).

Additional Publications available from the AFO Environmental Contaminants Branch

AFO-C88-1	A Preliminary Report of Mercury Effects on Fish from Mattawoman Creek (August 1988)
AFO-C88-2	A Biological Assessment of Wildcat Landfill Superfund Site (August 1988)
AFO-C89-1	Summary of Chesapeake Bay Environmental Contaminant Studies 1984-1988 (October 1988)
AFO-C89-2	An Assessment of Impacts to Eastern Painted Turtles at Wildcat Landfill Pond (November 1988)
AFO-C89-3	Environmental Contaminant Studies - A Summary. Annapolis and Gloucester Field Offices, 1984-1988. (March 1989)