D.C. Water Resource Research Center

Annual Technical Report

FY 1999

Introduction

? UNIVERSITY OF THE DISTRICT OF COLUMBIA Water Resources Research Center 4200 Connecticut Avenue, N.W. Building 52, Suite 322-D Washington, DC 20008 (202) 274-7124 (Office) (202) 274-7119 (Fax) June 26, 2000 Dr. John E. Schefter Chief, Office of External Research MS 424, U.S. Geological Survey 12201 Sunrise Valley Drive Reston, VA 20192 Re: Grant #: 1434-HQ-96-GR-02682 Dear Dr. Schefter: Attached is the FY 1999 Annual Report for the DC Water Resources Research Center. A hard copy of this report will be mailed because there were attachments that we were unable to transmit electronically. Please contact me if you have any questions regarding this report. Sincerely, Gloria S. Wyche-Moore, Ph.D. Interim Director, Water Resources Research Center Enclosure ? Abstract This report summarizes the activities of the D.C. Water Resources Research Center (WRRC) for the period of March 1, 1999 through February 28, 2000. Recovery efforts are on-going, as the D.C. WRRC has suffered from the impact of financial problems occurring in recent fiscal years at the University of the District of Columbia. The center has begun to work to reestablish the network of relationships that would enhance the unit's viability. Project funding was reinstated in FY 1999, making it possible to involve a University investigator and an investigator within the university consortium, thus moving toward the establishment of a credible program base. The Anacostia River is still a priority in the District of Columbia. The major environmental problems include nonpoint source runoff, storm water problems, toxic contamination of sediments, and loss of natural habitat for fish. Aligning with this issue, WRRC has provided funding for a UDC principal investigator in the study of D.C.'s Contaminated Anacostia Estuary Sediments. In support of this pressing issue, WRRC became an active member of a public- private consortium called the Anacostia Watershed Toxics Alliance and Mr. Clifford Lanham, former director, became a member of a WASA Advisory Committee. WRRC continues the work of the former director as it will continue to pursue relationships/partnerships with stakeholders on this issue to include American Rivers, Anacostia Watershed Society, Congresswoman Eleanor Holmes Norton, DC, Friends of the Anacostia, U.S. Environmental Protection Agency, and other organizations. Though there has been some lessening of concern for drinking water under the new Water and Sewer Authority (WASA) program, there are concerns that still remain for some populations. Thus, research emphasis was placed on drinking water. Specifically, WRRC awarded a seed grant to an investigator within the university consortium (George Washington University) to develop a proposal for submission to the U.S. Environmental Protection Agency (Office of Water) for funding. The proposal was developed for research on Cryptosporidium and Giardia (microscopic parasites) in Drinking Water Sources and subsequently submitted to EPA. The Center provided copies of reports, as requested for previously sponsored projects to the D.C. Environmental Health Administration and to a graduate student at George Washington University. WRRC will continue to disseminate the results of its research to its stakeholders to include the residents of the District of Columbia, and public and private agencies via newsletters, brochures, fact sheets, and information documents. Efforts are currently underway to develop a web page within the University's web site for the benefit of all who may seek information and/or assistance from the D.C. Water Resources Research Center. ii Water Problems and Issues in the District of Columbia The District of Columbia, like other cites, has many water-related problems and issues that the utility companies alone are unable to address. Therefore, a center for research, training, and advisory is a useful entity. A center such as WRRC also serves as a viable link of information to DC's residents and other stakeholders.

Some of the current problems and challenges facing the District of Columbia are described below. I. Anacostia River The Anacostia River water quality continues to be the most pressing issue in the District of Columbia. The Anacostia Watershed still suffers from chronic problems of NPS pollution from urban run-off, combined sewer overflows and sediments made toxic by past dumping and industrial activity. The River has incited the involvement of the U.S. Environmental Protection Agency, resulting in financial and technical assistance for study of the Anacostia River Watershed. As the major body of water of the District of Columbia, the Anacostia River is a distinctly unhealthy body of water, especially as compared to the Potomac estuary that the Anacostia joins. In addition to a consumption advisory on fish, the bottom life of the Anacostia is highly depauperate (Cummins e.a. 1991). The clams, mussels and submerged aquatic vegetation found in the nearby Potomac are missing in the Anacostia (Phelps 1985). Most problems of the bottom life in the Anacostia have been attributed to contaminants in the sediment (ICPRB 1991, 1992). However, evidence suggests problems may also come from toxic water conditions (anoxia & toxic ammonia) developing in the Anacostia basin in late summer. In recent years there has been an ever increasing demand for urban river restoration projects. This demand has been sparked by the amount of pollution that these rivers have endured over the years. Environmental degradation and other adverse effects emanating from pollution have indeed paved the way for some segments of the population to call for and initiate meaningful policies designed to restore these dying rivers. Heavily polluted river basins such as the Anacostia River basin have not been accorded the attention they deserve. There are those who question the efficacy of existing policies vis-a-vis river restoration projects, as well as those who claim that the failure to clear the Anacostia River rests on an issue of environmental equity. Whatever the reasons for this sad state of the Anacostia River; the paramount issue that confronts us is how we can implement the restoration of this precious resource to a healthy state and sustain and monitor this restoration. River pollution is a by-product of pollution from industrial and agricultural sources, as a result of the effects of urbanization. These problems are not only creating environmental degradation but are constantly being cited as serious health problems afflicting the local population. II. Drinking Water Cryptosporidium and Giardia are microscopic parasites that, if swallowed, cause diarrhea and stomach cramps in immunocompetent persons and severe illness in susceptible individuals. Crypto oocysts have been detected in surface waters and drinking water. Microbial contamination of drinking water frequently results in gastrointestinal symptoms and can cause disease such as Cryptosporidiosis, giardiasis or hepatitis. Crypto and giardia have caused a number of waterborne disease outbreaks in the U.S. The raw water contains a variety of viruses and pathogens, which originate from many sources, including, agricultural inputs. Usually, the treatment plant is supplied with source water from a river where the watershed is dominated by agricultural activity. Studies show the occurrence of Crypto at different levels in nearly all surface waters that have been tested nationwide. The water treatment plants remove most viruses and pathogens from raw waters by various treatment processes such as coagulation, sedimentation, filtration, ozonation, and chloride disinfection. However, Crypto oocysts are insensitive to disinfecting and no drinking water processing plant is 100% efficient, even when it is operated correctly. Therefore, viruses and pathogens find their way to our taps through the drinking water supply system. Drinking water is an important path for exposure to Crypto and giardia. There have been an increasing number of outbreaks of waterborne Cryptosporidiosis and giardiasis nationwide. Locally, the Water and Sewer Utility Administration serves the District of Columbia and provides surface water to about 600,000 urban customers. This system has reported numerous violations to EPA in the past decade. There were threats of waterborne Crypto outbreaks in 1994 and 1996 in the District of Columbia. III. Water Resources A. Surface Water The District of Columbia covers an area of 69 square miles and is completely urban in land use. The climate is typical for the Mid-Atlantic Region, with moderately cold winters and hot and humid summers. Precipitation averages 40 inches per year and is distributed fairly evenly throughout the year. The city lies within the Potomac River Basin, the second largest tributary to the Chesapeake Bay. Historic average annual flows of the Potomac River are 11,500 million gallons per day (for period 1930-1991; USGS, 1991) at Little Falls, just west of the District line. Lowest flows occur between July and September, high flows follow the spring thaw in March and April. The Potomac River provides the drinking water supply for the city. Water is diverted at the Great Falls intake and treated at the McMillan and Dalecarlia Treatment plants before being distributed to users throughout the city. The District portion of the Potomac, together with its main tributary, the Anacostia, constitutes a freshwater estuary with tides up to three feet. Thirty (30) smaller streams, tributaries to either the

Anacostia or Potomac, drain the District's urban and park land. The Center has several reports describing DC water resources. B. Ground Water The District of Columbia straddles the Mid-Atlantic Fall Line, which divides the Piedmont Province in the west from the Atlantic Coastal Plain Province in the east. Ground water occurs both in the bedrock of the Piedmont and in the consolidated deposits of the Coastal Plain. Aquifers exist under confined, unconfined and perched conditions. Aquifer productivity ranges from less than 1 gallon per minute in the Piedmont Province to more than 300 gallons per minute in the confined interstate Potomac Group Aquifer in the Coastal Plain Province. The natural ground water quality in the Piedmont Province is characterized by high iron contents (up to 34 ppm) and soft to moderate hardness dominant in calcium bicarbonate. The Atlantic Coastal Plain ground water has iron contents of up to 5 ppm, is soft to moderately hard with a prevalence of calcium magnesium hardness. While a Ground Water Resources Assessment Study conducted by DC WRRC found the ground water in both provinces to be generally unaffected by pollutants (DC WRRC Reports No. 136,137,138), another DC WRRC study (Schneider et al., 1992) identified areas of high ground water vulnerability to contamination along the rivers, indicating the potential for local contamination of the city's aquifers. Ground water is not used as drinking water supply in the District of Columbia, however, a health hazard to residents from contaminated ground water in the shallow aquifers cannot be excluded at this point. Additionally, since the District does not have an alternative water supply source besides the Potomac at Great Falls, ground water could be evaluated as a potential supplemental drinking water source during an emergency. Program Goals and Priorities Water problems and issues of the District of Columbia have generally remained the same for the last four years as expressed by the former WRRC administration to include water resources (surface water, ground water), the Anacostia River, and drinking water. There has been some lessening of concern for drinking water under the new Water and Sewer Authority (WASA) programs (although concerns remain for some populations) and some renewed emphasis on NPS pollution under the Clean Water Action Plan. The Anacostia River water quality continues to be the most pressing issue in the District of Columbia. The Anacostia watershed still suffers the chronic problems of NPS pollution from urban run-off, combined sewer overflows and sediments made toxic by past dumping and industrial activity. During the past year, the Center has become an active member of a public-private consortium called the Anacostia Watershed Toxics Alliance and the former Center Director, Mr. Clifford Lanham, became a member of a WASA Advisory Committee. The core of program development is active participation in the DC community concerned with water resources and local environmental issues. In general, WRRC must establish and maintain relationships with six (6) groups of persons and organizations. These groups are: 1) UDC faculty and academic departments; 2) UDC administration; 3) Federal science and technology agencies; 4) local environmental organizations; 5) DC and other local water and environmental agencies; and 6) the local community Last year the emphasis was on broadening support from the first two of these groups. This year, understanding and organizing the expertise in the entire DC university community will be the main thrust. Using the base program funding, the WRRC will continue to develop relationships and seek to identify the priority water resource and watershed environmental issues which need to be addressed, identify credible investigators and project teams for a coherent and high quality program. PROGRAM GOALS GOAL ONE: Formation of an Advisory Committee & Research Evaluation Committee The WRRC intends to complete the formation of an Advisory Committee composed of key people in local agencies and influential environmental organizations. The Advisory Committee has been formed , in part, with the agreed participation of the following individuals: 1. Mr. James Collier, Chief of the Water Quality Division of the DC Environmental Health Administration; 2. Dr. Philip Ogilvie, DC Commissioner on the Interstate Commission for the Potomac River Basin; and 3. Dr. Richard Jachowski, Chair, Scientific and Technical Advisory Council of the Bay Program. Representation in still being sought including the Army Corps of Engineers Chief of the Washington Aqueduct, the DC Water and Sewer Authority (WASA), and the head of the environmental group of the Washington COG. In a similar manner, a Research Evaluation Committee composed of highly qualified and respected scientists will be formed to evaluate proposed research projects. The establishment of this committee is a priority activity for this grant year, since it will provide the "peer review" for the continuing Seed Grant Program and for the broader based program next year. GOAL TWO: Reestablishment of Relations with other District of Columbia Universities This goal is being addressed in the process of forming the Evaluation Committee and pursuing the Seed Grant initiative. It will be enhanced downstream by joint activities under the information transfer part of our program, such as the development of an expertise database and jointly sponsored seminars. GOAL THREE: Greater Outreach to Stakeholders & Committee Input Greater outreach to stakeholders and input from aforementioned committees will efficiently provide better judgment on where to invest effort and will enhance credibility for a more balanced and relevant future program. Increased partnerships with other universities will provide the Center with a broader capability to respond to the major water resource issues of the District of Columbia. PROGRAM PRIORITIES The most pressing water resources priorities in the District of Columbia are the restoration of the Anacostia River, the Potomac source water protection and the Combined Sewer Overflow problem, followed by the design and implementation of a ground water protection program. Other issues are toxins in drinking water, strong minority training, and public education and outreach. WRRC will work to develop partnerships, identify researchers, and to extend information and education to the community.

Research Program

Basic Project Information

Basic Project Information	
Category	**Data**
Title	DC's Contaminated Anacostia Estuary Sediments: A Biomonitoring Approach
Project Number	99-12
Start Date	03/01/1999
End Date	02/28/2000
Research Category	Water Quality
Focus Category #1	Sediments
Focus Category #2	None
Focus Category #3	None
Lead Institution	D.C. Water Resource Research Center

Principal Investigators

Principal Investigators			
Name	**Title During Project Period**	**Affiliated Organization**	**Order**
Harriette L. Phelps	Professor	University of the District of Columbia	01

Problem and Research Objectives

? Summary The purpose of this project was to explore the bioavailability of Anacostia sediment contaminants to the local Asiatic clam (Corbicula fluminea). In May 1999 we collected surface sediments by hand (6” Ekman dredge) from three tidal Anacostia river estuary sites: Navy Yard (lower third), Kingman Island (middle) and Bladensburg Marina (upper tidal end). The sediments were kept cool and the next day we collected adult Asiatic clams at Fort Foote on the Potomac River estuary where clams are prevalent. We placed clams in mesh-covered plastic trays of Anacostia sediments at that site. Clams were also placed on control Potomac sediment trays at Fort Foote and in the Northwest Branch (MD) of the Anacostia. The trays were collected at 11 weeks. Pre and post EPA

Priority Pollutant analysis of sediments and clam tissues included five metals, pesticides, PAH's, PCB congeners and TOC. The sediment pesticide PAH and metal levels were highest in middle and upstream Anacostia sites and in the accumulated Northwest Branch sediments (post sampling). Sediment TOC-normalized heptachlor, chlordane and DDE concentrations were above upper effects threshold at some upstream sites (SQuiRT criteria). Chlordane, a major Anacostia toxic of concern, was only found in the two most upstream locations, Bladensburg and the Northwest Branch. The original control site Potomac clams collected on 5/17/99 had high tissue levels of pesticides, PCB'S, PAH's and metals, although the Potomac site sediments had few contaminants. After 11 weeks in the Potomac both the sediments and the tissues of clams in contact with the Anacostia sediments (as well as control site clams) lost most pesticides, PAH's and PCB's. Metals in clam tissues were not lost but also not increased by contact with Anacostia sediment. Sediment and clams placed in the Northwest Branch accumulated the highest levels of chlordane and some PAH's. These results confirm upstream sources of major contaminants in the Anacostia estuary. They suggest preferential bioaccumulation of contaminants by Corbicula from the water column vs sediment exposure. And they show the Potomac estuary Asiatic clam population (not present in the Anacostia) can accumulate contaminants on a seasonal basis, possibly partly through tidal exchange and downstream transport of contaminants from the Anacostia estuary. Background The 10 km Anacostia River tidal freshwater estuary flows into the Potomac River tidal freshwater estuary and is the only major water body almost entirely within the District of Columbia. The Anacostia estuary of Washington, DC has a Superfund site on its lower third and its benthic community is highly depauperate. It is listed as one of three Areas of Concern in the Chesapeake Bay by the Chesapeake Bay Program and as one of America's ten worst rivers by the American Rivers Association. Concentrations of sediment contaminants varied considerably over the length of the estuary (Wade e.a. 1994, Velinsky e.a. 1992, Velinsky e.a. 1994). The nearby Potomac estuary has a large healthy benthic community (including Asiatic clams) which is almost completely absent from the Anacostia (Phelps 1985, 1987, 1994; Freudberg e.a. 1988; Cummins e.a. 1991). To separately test the effects of Anacostia sediment and water toxics, transplant experiments placed adult clams from the Potomac on Anacostia and Potomac sediment trays that were put in the lower Anacostia at the Navy Yard site and in the nearby Potomac (Phelps 1987). Clams put on Anacostia sediment at both locations showed no significant mortality but also no clam reproduction (Dougherty and Cherry 1988). Young clams developed on trays of Potomac sediment in the Potomac but those growing on Potomac sediment in the Anacostia all died in late summer, suggesting a seasonal water-column toxic event at the Navy Yard site. A four-day sediment bioassay using Asiatic clam larvae was developed (Phelps and Clark 1988). It was used to map the toxicity of Anacostia estuary sediments, and found three statistically different levels of sediment toxicity (Phelps 1991, 1993). The most toxic sediments were on the north (city) side of the lower Anacostia in the basin region near the Navy Yard, followed by lower toxicity sediments up to the New York Avenue bridge, and no toxicity in sediments of the upper estuary to Bladensburg (head of tide). A later study found high toxicity in mid-estuary Kingman Lake sediments (Phelps unpub.). Raising sediment pH to convert ammonia to the toxic (un-ionized) form caused 100% mortality in clam larvae with lower Anacostia sediment (Navy Yard site), but not clam larvae with Potomac control sediment (Ankley, e.a. 1990; Phelps 1990). With a multisensor sonde, UDC found lower Anacostia basin water in September reached a pH of 8.6 at a temperature of 24 deg. C, which would be sufficient to convert 30% of natural ammonia to the un-ionized toxic form. Ammonia from the high- organic Anacostia sediment at that site may have caused the late-season 100% mortality of the young clams in the sediment trays. To complete the Sediment Quality Triad approach (Chapman e.a. 1987), EPA Priority Pollutants were analyzed in sediment sample from the Navy Yard site and sediment from the Potomac control site at Fort Foote (Phelps 1993). No pollutant concentrations in Navy Yard sediment exceeded ET-L or ER-M effects levels (Long and Morgan 1990) and only copper and zinc were increased over the control sediments. The Navy Yard sediment sample was taken one day following a rain event and there was evidence of fresh sediment deposition and the larval clam bioassay found no toxicity. Sediments taken other times at the

Navy Yard site have been reported with possibly toxic levels of DDT, chlordane, PAH's, zinc and lead (Long and Morgan 1990; ICPRB 1991, 1992). However, these sediment pollutant concentrations were highly variable over three years and showed no consistent trend (Phelps 1995).

Methodology

? Methods 5/15/99 Surface sediment samples were collected using 6" Ekmann dredge from tidal freshwater Anacostia River sites: Navy Yard, Kingman Lake and Bladensburg Marina. GPS location of sites was recorded. Subsamples of sediments were taken for analysis and kept on ice. 5/16/99 Sediments were translocated to plastic boxes with mesh lids at the Fort Foote site on the tidal freshwater Potomac River estuary, 5 km below the confluence with the Anacostia River estuary. Asiatic clams were collected at Fort Foote and added to the sediment cages. Control sediment was taken at Forte Foote. Fort Foote clams were taken for tissue analysis. Clams were depurated for 24 hours in three changes of spring water and frozen for tissue removal. 5/17/99 Sediment (kept cool) and frozen clam tissue samples were hand-carried to Severn-Trent Laboratories, Sparks, MD, for EPA Priority Pollutant analysis. 5/18/99 Control (Fort Foote) sediment and clams placed in a cage at the Northwest Branch (MD)of the Anacostia, near the estuary head of tide. 8/5/99 (11 weeks) Clams and sediments were collected from Fort Foote and from the Northwest Branch. A second sample of Potomac sediment and clams was taken. Sediment samples were kept on ice. Clams were depurated 24 hours and tissues removed and frozen as before. 8/6/99 Sediment and clam samples were hand-carried to Severn-Trent Laboratories, Sparks, MD, for EPA Priority Pollutant analysis as before. 6/12/00 Most site GPS positions were re-recorded because of signal improvement but barriers prevented this at the Bladensburg Marina and Fort Foote sites. The Asiatic clams selected for this research at the Potomac Fort Foote site were the 1998 fall cohort with shell lengths ranging from 18 to 25 mm. Clam tissues were around one gram each and 47 - 56 were composited to obtain 60 grams for two complete Priority Pollutant analyses per site. One set of sediments and one of clam tissue were spiked for pollutant recovery control. At the Northwest Branch site only 24 grams were obtained (one cage) so the PCB congenor analysis was omitted. Sediment and clam tissue pollutant concentration correlations were examined by Excel.

Principal Findings and Significance

? Results TABLE 1. SITE GPS LOCATIONS N W Northwest Branch (MD) 380 56.667' 760 56.768' Bladensburg Marina (Anacostia) 38O 56.199' 76O 56.425' Kingman Island (Anacostia) 38O 53.700' 76O 58.030' Navy Yard (Anacostia) 38O 52.350' 76O 59.825' Fort Foote (Potomac) 38O 46.423' 77O 01.648' Pesticides: Sediments from the three Anacostia sites had only a few pesticides above detection limits: 4,4'DDE, aldrin, alpha and gamma chlordane, endosulfan II and heptachlor epoxide (Table 1). No pesticides were detected in Potomac sediments. Sediment pesticide levels were highest in the middle and upper Anacostia estuary sites. Kingman Lake sediments had upper effects level (UET) concentrations of the pesticides DDE, aldrin and heptacholor epoxide, and Bladensburg sediments had UET of chlordane and heptacholor epoxide (Buchman 1999). The Anacostia sediments held in the Potomac for 11 weeks lost all pesticides (below detection limits). However Potomac sediment held in the Northwest Branch tray accumulated total organic material (TOC) and alpha chlordane. There was no correlation between sediment pesticide concentrations and organic content. Tissues of the original Potomac clams had 4,4'DDE, endrin, alpha and gamma chlordane but were missing aldrin, heptachlor epoxide and endosulfan II that were present in the Anacostia sediments (Table 2). After 11 weeks the clams held on Potomac sediments in the Potomac lost all pesticides. After exposure to Anacostia sediments held in the Potomac, the clams lost some pesticides but picked up endrin aldehyde and heptachlor which were not detected in Anacostia sediments. The clams held in the Northwest Branch accumulated alpha chlordane and heptachlor epoxide, which were found in Anacostia sediments. Chlordane has been a toxic of concern in the Anacostia and reported in sediments of the lower Anacostia as well as fish tissues and the dissolved and particulate fractions of Northwest Branch water (Wade et al 1994, Velinsky and Cummins 1994, ICPRB 1997). In this study, chlordane was found only in the up-estuary sediments of Bladensburg and the Northwest Branch, and only in tissues of the original Potomac clams (5/17) and the clams exposed at Northwest Branch. The absence of detectable chlordane in surface sediments below the uppermost end of the estuary at Bladensburg suggests a present source is upstream and the formerly contaminated downstream estuary sediments are becoming moved or capped. This could decrease the bioavailability of chlordane to fish in the Anacostia and suggests a re-evaluation of the 1995 pesticide-based ban on Anacostia fish consumption. It also indicates natural remediation of lower Anacostia estuary chemically contaminated sediments may be taking place. PAH's: Anacostia sediments had highest PAH's in Kingman Lake (middle Anacostia) where several PAH's were above upper effects threshold levels (SquiRT, Buchman 1999)) (Table 1). Sediments accumulating in the Northwest Branch tray had total PAH's comparable to those at the Navy Yard site. Wade e.a. (1994) reported highest PAH levels in upper Anacostia sediments and Coffin e.a. (1999) found suspended sediments with the highest PAH levels in the upper Anacostia. Anacostia sediments held in the Potomac for 11 weeks had both increased and decreased concentrations of various PAH congenors. The Potomac sandy sediment at the Fort Foote control site on 5/17 had very low levels of PAH's, and none above detection limits on 8/6. No Aroclor congenors (1016, 1221, 1232, 1242, 1248, 1254, 1260; detection limits 43 - 87 ug/kg) were found in any sediments or clam tissues. Total sediment PAH's (TPAH) were calculated by summing up and were highest at Kingman Lake (10.6 mg/kg). However, when TPAH were normalized for total organic carbon (TOC) no Anacostia sediments exceeded the Probable Effects Level (PEL) for biological effects (804 TPAH ug/g organic carbon; Swartz 1999). Clams accumulated only six of 18 PAH congenors measured in sediments. Highest tissue PAH concentrations were in the original Potomac clams (5/17) with acenapthylene (340 ug/kg) leading. Acenapthylene was not found in Anacostia sediments and may be unique to the Potomac. Clams at the Northwest Branch site accumulated the second highest number (5) of PAH congenors, but again no acenapthylene. TPAH's in clam tissues fell when the clams were exposed in the Potomac on trays of Anacostia sediments. Since the lowest TPAH was in Potomac sediments it appears Asiatic clams PAH concentrations reflect water column but not sediment levels. In the lower Anacostia, brown bullheads show PAH accumulation in bile and a high incidence (50 - 60%) of liver neoplasms which may be better bioindicators of Anacostia sediment PAH effects although the bullhead range has yet to be established (Pinkney e.a. 2000). PCB's: Because the Asiatic clam is nearly ubiquitous now in US freshwaters and not an endangered species, the USGS National Water-Quality Assessment (NAWQA) program specifically recommends Asiatic clam tissues for analysis of locally bioavailable contaminants (Crawford and Luoma, 1993). The Asiatic clam is considered an especially good bioindicator of PCB's (Peterson e.a. 1994). Similar to the findings of Smith and Ruhl (1996) for the Albemarle- Pamlico Drainage Basin, a number of major banned organochlorines of concern were found in the Potomac Asiatic clam tissues: p,p'-DDE, chlordane, endrin, heptachlor epoxide and total PCB's. However, no concentrations came close to the NAS/NAE recommended maximum clam tissue concentrations (1000 ug/kg wet weight for p,p'-DDE, 100 ug/kg wet weight for chlordane, endrin and heptachlor epoxide, and 60 ug/kg wet weight for total PCB's) (Table 2 clam tissue values are for dry weight, estimated as 4.5X wet weight concentrations). The contaminant concentration closest to the NAS/NAE recommended level was total PCB's in clams originally collected from the Potomac control site for use in this study. The Potomac control site sediments had no detectable PCB's. After 11 weeks in the Potomac both the Anacostia sediments and clams lost significant amounts of PCB's. PCB effects of sediments have been correlated with total PCB concentration (TPCB) (MacDonald et al. 2000). The highest sediment TPCB's were the three up-estuary sites of Bladensburg, Kingman Island and Northwest Branch. The sediment TPCB's of Kingman and Bladensburg (0.139 and 0.125 mg/kg) were above the consensus freshwater sediments threshold effects concentration (TEC) of 0.04 mg/kg but lower than the moderate effects concentration (MEC) of 0.40 mg/kg. This range was reported to have a low incidence (7%) of adverse biological bioassay effects. The highest clam tissue TPCB's were the 5/17 original Potomac clams and clams exposed to the Navy Yard site sediment. These sediments had the two lowest TPCB's, which suggests the clam tissue TPCB accumulation was not related to sediment TPCB exposure. Since 26 PCB congenors were analyzed it was possible to compare relative PCB concentration profiles by Pearson correlation. All tissue PCB profiles correlated with each other and all sediments with each other ($p = 0.05\%$). The broadest correlation between clam tissue and sediment congenor profiles was original Potomac pre-exposure clams which correlated with all sediment PCB profiles except Potomac. Post-exposure, the tissues with greatest total PCB concentrations (Potomac and Navy Yard) correlated positively with the sediment with the greatest total (Bladensburg). The remaining post-exposure tissue and sediment PCB profiles did not correlate. Total organic carbon (TOC) normalization found significant concentrations of organic contaminants only in the sediments of the mid and upper Anacostia, at Kingman Lake and Bladensburg. TOC-normalized PCB concentrations were highest at Kingman Lake and the Northwest Branch (post) sediments. Metals: In original Anacostia sediments the metal concentrations (Cd, Cr, Cu, Fe, Zn) increased up-estuary, and were highest in the Bladensburg Marina sediments. The accumulated sediment in the Northwest Branch tray had relatively high metal concentrations, similar to Kingman Lake. All sediment metal concentrations were positively correlated with sediment TOC concentration, unlike the organic contaminants (total PCB's, total PAH's and pesticides). Clams in the Potomac on Anacostia sediments did not lose as much metal as they lost pesticides, TPAH's, and TPCB's. However clam tissue metal concentrations did not increase significantly with 11 weeks of exposure to the higher (5X to 65X) metal concentrations of Anacostia sediments. The original (5/17) Potomac clams had highest tissue metal concentrations although their Potomac sediments had lowest sediment metal concentrations. The metal concentrations in clam tissues and sediments were not correlated, similar to the finding of Harrison (1984) who studied metals in Asiatic clam tissues and sediments of the tidal Potomac. Harrison's average clam size and tissue concentrations of Cd, Cu, Fe and Zn were similar to those in the present study. These results indicate that metals in tissues of the filter-feeding Asiatic clam retain metals and probably reflect water column exposure rather than sediment exposure. Initial high tissue metal levels may have been residual contamination from exposure to high metal levels in Potomac water earlier in the year. Tissues of translocated mussels take up to three months to reflect the metal concentrations in a new environment (Roesijadi e.a.. 1984). General: In the Anacostia the most chemically contaminated sediments (most pesticides, highest metal levels etc.) were at the middle and upstream sites and also in the Northwest Branch (MD). Some of the sediment contaminant concentrations were above "probable effects levels". This suggests much Anacostia sediment chemical pollution may be coming from Maryland. Since a majority of lower Anacostia estuary water comes from the Potomac by tidal exchange there may be influx of Potomac sediments and capping of sediment pollutants in the lower estuary. In general, the Asiatic clams placed on Anacostia sediments did not accumulate significant additional pollutants in the 11 weeks Potomac exposure. It appears the clams accumulated chemicals from the water but not the sediments, no matter what types or amounts of contaminants were in the sediments. Sediment contaminants were apparently not readily bioavailable to the clams. This is also true for other filter feeding molluscs that live in surface sediments but do not feed on sediment (Phelps 1979). The Asiatic clam is such an efficient high-volume filter feeder it can clear the water enough to cause ecological change and has been tried in biological water purification systems (Haines 1977; Lauritsen 1986, Phelps 1994). The uptake of chemical pollutants only from the water column may explain why the most contaminated clams were those originally collected from the Potomac on 5/17 though the Potomac sediments had almost no detectable chemical pollutants. It is possible the heavy Spring rains carried pollutants from the mouth of the Anacostia downstream five km to the Potomac Fort Foote site, where they were found in clam tissues collected on 5/17 but not 8/6/99. Coffin et al.

(1999) reported highest Anacostia river flows in February. Several pollutants (endrin, endrin aldehyde and acenapthylene) were found only in the Potomac clams. These may be signature pollutants for sources of Potomac chemical contamination other than the Anacostia. These findings need to be confirmed with further study. By the end of this study in August both the clams and Anacostia sediments in the Potomac had lost most of their organic pollutants such as pesticides and up to three quarters of their metals. The Asiatic clam is doing well and reproducing in the Potomac at Fort Foote, so the large clam population there (Phelps 1971)is apparently not being affected by the short-term spring accumulation of tissue pollutants that may be coming partly from the Anacostia. These results suggest future studies need to look beyond the contaminated sediments of the Anacostia for the sources of toxicity to Anacostia bottom life. We hope to be making long- term measurements of water quality in the lower Anacostia for water column toxics that may indicate why there are no clam populations now living in the lower Anacostia. This research can assist decisions to clean up the Anacostia to develop the healthy bottom life and good fishing of the nearby Potomac. A clean and attractive Anacostia is one of the major goals of Mayor Anthony Williams' administration.

Descriptors

Articles in Refereed Scientific Journals

Book Chapters

Dissertations

Water Resources Research Institute Reports

Conference Proceedings

Other Publications

Basic Project Information

Basic Project Information	
Category	**Data**
Title	Characterizing the Occurrence of Cryptosporidium and Giardia in Drinking Water Sources
Project Number	99-11
Start Date	03/01/1999
End Date	02/28/2000
Research Category	Water Quality
Focus Category #1	Water Quality
Focus Category #2	None
Focus Category #3	None

Lead Institution	D.C. Water Resource Research Center

Principal Investigators

Principal Investigators			
Name	**Title During Project Period**	**Affiliated Organization**	**Order**
Reza Modarres	Associate Professor	Other	01

Problem and Research Objectives

? Microbial contamination of drinking water frequently results in gastrointestinal symptoms and can cause diseases such as Cryptosporidiosis, giardiasis or hepatitis. Crytpo and giardia have caused a number of waterborne disease outbreaks in the U.S. The raw water contains a variety of pathogens, which originate from many sources, including agricultural inputs. Studies show the occurrence of Cryptosporidium at different levels in nearly all surface ? waters that have been tested nationwide. The water treatment plants remove most viruses and pathogens from raw waters by various treatment processes. Cryptosporidium oocysts are insensitive to disinfection and no drinking water processing plant is 100% efficient, even when operated correctly. Therefore, viruses and pathogens find their way to our taps through the drinking water supply system. Drinking water is an important path for exposure to Crypto and giardia. There have been an increasing number of outbreaks of waterborne Cryptosporidiosis and giardiasis nationwide. Locally, the Water and Sewer Utility Administration serves the District of Columbia and provides surface water to about 600,000 urban customers. This system has reported numerous violations to EPA in the past decade. There were threats of waterborne Crypto outbreaks in 1994 and 1996 in the District of Columbia. There is a tradeoff between the control of mircrobiological contamination (bacteria, viruses, and protozoa) and disinfection byproducts. Usually, increasing one decreases the other and vice versa. Moreover, disinfection byproducts may lead to increased cancer rates. Concerned with such tradeoffs, the Information Collection Rule (FR, 1996) requires large public water systems (systems serving at least 100,000 people and ground water systems serving at least 50,000 people) to collect information on the occurrence and levels of microbial contamination and disinfection byproducts. In order to assess the levels of chemical and microbial contaminant in nation's waters, 400 drinking water sources (lakes, rivers, flowing streams, and groundwater) have provided monthly samples, over an 18 month period. Such samples were tested for the presence and levels of Crypto and giardia among other chemical and microbial contaminants.

Methodology

? Exploratory analysis was performed to study the distribution of occurrence of the microbial contaminants (bacteria, viruses, and protozoa) of water body, region, and season. Also, the joint occurrence of cryptosporidium and giardia was studied. Computer programs to perform initial modeling of the data were developed.

Principal Findings and Significance

The DC Water Resources Research Center awarded Dr. Reza Modarres of The George Washington University, a seed grant for this project. The seed grant assisted in the development of a proposal that was submitted to the U.S. Environmental Protection Agency.

Descriptors

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Information Transfer Program

Basic Project Information

Basic Project Information	
Category	**Data**
Title	"Stakeholders" Database
Description	Database of persons and organizations concerned with water resource and local watershed issues in the District of Columbia and the region
Start Date	03/01/1999
End Date	02/28/2000
Type	Library And Database Services
Lead Institution	D.C. Water Resource Research Center

Principal Investigators

Problem and Research Objectives

? The main emphasis of the Center has been has been directed to implementing its information transfer programs for the benefit of local and regional constituencies. The Center continued a variety of scheduled activities including a seminar, publication distribution, and database projects. Two database projects were begun this last year and will be continued and expanded in this coming year. The first is a “Stakeholders” database of persons and organizations concerned with water resource and local watershed issues in DC and the region. This database is intended for internal use by the Center in the near term, as its structure is evolving. It will be structured to provide information on stakeholders prioritized areas of concern and contacts within the organizations with special interests. This will allow the targeted transfer of information and the rapid organization of concerned groups to discuss developing issues. The second is a directory of expertise in the universities in the District, or possibly in the metropolitan area. It is intended that this directory be provided as a searchable web database accessible from the Consortium of Universities web site among others.

Methodology

Principal Findings and Significance

Articles in Refereed Scientific Journals

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Basic Project Information

Basic Project Information	
Category	**Data**
Title	Kenilworth-Kingman Marsh Symposium
Description	Symposium
Start Date	02/01/2000
End Date	02/01/2000
Type	Conferences
Lead Institution	D.C. Water Resource Research Center

Principal Investigators

Problem and Research Objectives

? The main emphasis of the Center has been has been directed to implementing its information transfer programs for the benefit of local and regional constituencies. The Center continued a variety of scheduled activities including a seminar, publication distribution, and database projects. Following the success of the Kenilworth-Kingman Marsh Symposium in February 2000, the Center plans to organize a series of seminars and symposia during the coming year. It is intended that these will take place with joint sponsorship and participation from other organizations. These are intended to encourage interaction among numerous groups and organizations that can contribute to the clear exposition and resolution of the issues considered. It should also provide excellent visibility for the Center as a valuable participant in the community and aid in structuring the future research agenda.

Methodology

Principal Findings and Significance

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USGS Internship Program

Student Support

Awards & Achievements

Publications from Prior Projects

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