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Research Note: PCBs in the Acushnet River Estuary

Jacek Sulanowski
Bridgewater State College

McCarthy would cooperate with the New Administration. But to Ike's dismay the Senator, now Chairman of the Government Operations Committee, stepped up his campaign to ferret out Communists. Eisenhower personally loathed McCarthy, but hesitated to grapple with him, explaining, "I will not get in the gutter with that guy."

McCarthy began his campaign with an investigation into subversion in the Voice of America, the government agency for overseas broadcasts. His chief counsel, Roy Cohn, and committee staff assistant G. David Schine, made a highly publicized tour of American information offices in Europe, searching for subversive books and terrorizing employees.

By early 1954, McCarthy was at the height of his power. A Gallup Poll of January 1954, reported that fifty percent of those interviewed expressed a favorable opinion of him. But when, in his increasingly reckless course, he turned his guns on the United States Army, the Eisenhower Administration broke with McCarthy. At issue was whether the Army was protecting and even promoting Communists. The Army fought back, charging that Roy Cohn had sought preferential treatment for his sidekick G. David Schine, who had been drafted in 1953.

The clash became the subject of a Senate investigation which was televised from April 22 to June 17. Like the later Watergate hearings, it was compelling drama, attracting millions of viewers, who quickly realized that McCarthy was a crude and cruel bully. As one columnist observed, "No one who saw that flower of evil will ever forget it."

The dramatic highlight, which assured McCarthy's denouement, occurred when the Army counsel, Joseph Welch, outraged by McCarthy's attack on a young colleague, cried out, "Until this moment, Senator, I think I never really gauged your cruelty or your recklessness . . . And he added, "Have you no sense of decency, Sir, at long last?" The gallery applauded and McCarthy's bullying days were over. In December 1954, the Senate nerved itself against his insults and voted to "condemn" McCarthy. Thereafter McCarthy was a voice in the wilderness, snubbed by all, save the hard-core Red baiters. His death from alcoholism, in 1957, "merely ratified his political demise," as one writer put it.

Before McCarthy's self-destruction, he disrupted two Administrations, besmirched American political life, lowered morale throughout the federal government, and contributed to a rigid foreign policy that stifled debate and inhibited the American government for years to come. McCarthy encouraged censorship, blacklists, and loyalty oaths and, while he never uncovered a single Communist, many hundreds suffered because of his obsession with subversion.

McCarthy operated in troubled times, but his brief success serves to remind us that the fabric of civil liberties is fragile and that "Great Simplifiers" are dangerous. People like McCarthy get their chance when fear and ignorance become tangled, when people do not understand life or history's complexities. While some liberals of the '50s thought they saw an emerging dictator and recalled the last days of Germany's Weimar Republic, McCarthy was no Hitler -- he had no program, his ambitions were limited. But this is no reason for complacency. Even the most optimistic student of American history must consider the possibility that in another national crisis, a real Fuehrer could emerge to tantalize us with simple solutions to complex problems.

RESEARCH NOTE

PCBs In The Acushnet River Estuary

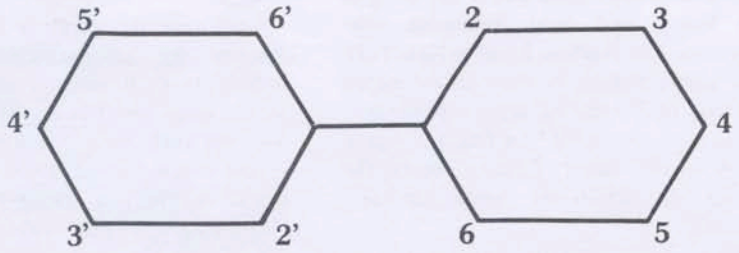
by Jacek Sulanowski
Assistant Professor of
Earth Sciences and Geography

Much media attention has recently been devoted to potentially toxic substances disseminated throughout various components of the environment. In almost every case these substances had been manufactured and distributed under the assumption that they did not pose a threat to man. Indeed when tested by methods current at the time of their initial introduction the substances were considered benign. It was only later when technologically advanced and more sensitive methods of analyses were developed that the presence of these substances was considered to be of real concern. Unfortunately, in the interval between introduction and detection, the accumulation of these substances had frequently reached staggering proportions.

Under these circumstances, the problem can no longer be solved by the simple expedient of cessation of production. Methods must be devised to deal with the already accumulated substances. Frequently, because of the urgency, these methods constitute only stop-gap measures which do little more than transfer the pollutants from one environmental component to another while awaiting the development of technology which will permanently neutralize the pollutants.

Polychlorinated biphenyls (PCBs) are but one example of such substances. Originally made commercially available in 1929, they share with many other halogenated hydrocarbons the characteristic of excellent resistance to degradation. From the time of introduction through 1975, approximately 600 million kilograms (kg) of PCBs were produced in the United States alone. These compounds were found to be extremely useful in a wide variety of industrial applications. Their stability at high temperatures and voltages made them ideal lubricating and insulating oils respectively. Also related to their stability was their use to extend the life of certain pesticides. Other applications included their incorporation in the manufacture of rubber and plastics as corrosion and flame retardants. Paradoxically this stability, which caused the PCBs to be so attractive in industrial and agricultural applications, is also the source of their environmental liability. Nearly the entire amount produced since their introduction can be accounted for. More than half of the total is still in service and only approximately four percent has been degraded or incinerated. Of the remainder it is estimated that 130 million kg are located in landfills or equipment dumps and 68 million kg have been released into the environment.

Figure 1
General Structure of
polychlorinated biphenyls



Polychlorinated biphenyls) (PCBs) comprise a large number of organic compounds where several chlorine atoms occupy different positions on the ten carbon atoms of the biphenyl rings, giving rise to related chemicals known as isomers. About one hundred such PCB isomers, each with its unique physical and chemical properties, have been manufactured by Monsanto Chemicals, U.S.A. Although the solubility of isomers generally decreases with increasing numbers of chlorine atoms on the biphenyl ring, each member of PCBs often exhibits unexpected properties leading to detrimental effects on the environment.

Sufficient data now exists which indicates that PCB mixtures have an adverse effect on biological systems. These effects range from disruption of community structure in certain marine systems to reproductive dysfunction in subhuman primates and include carcinogenicity in laboratory organisms. The observed effects of PCB mixtures on humans have to date been limited to relatively minor impairments such as abnormal skin eruptions (chloracne). Carcinogenic effects of PCBs on human populations cannot at the present time be unequivocally determined due in part to the lack of a sufficiently long latency period. However, the lack of clear-cut causal relationships should not be construed as indicating that PCBs do not pose a serious potential health risk.

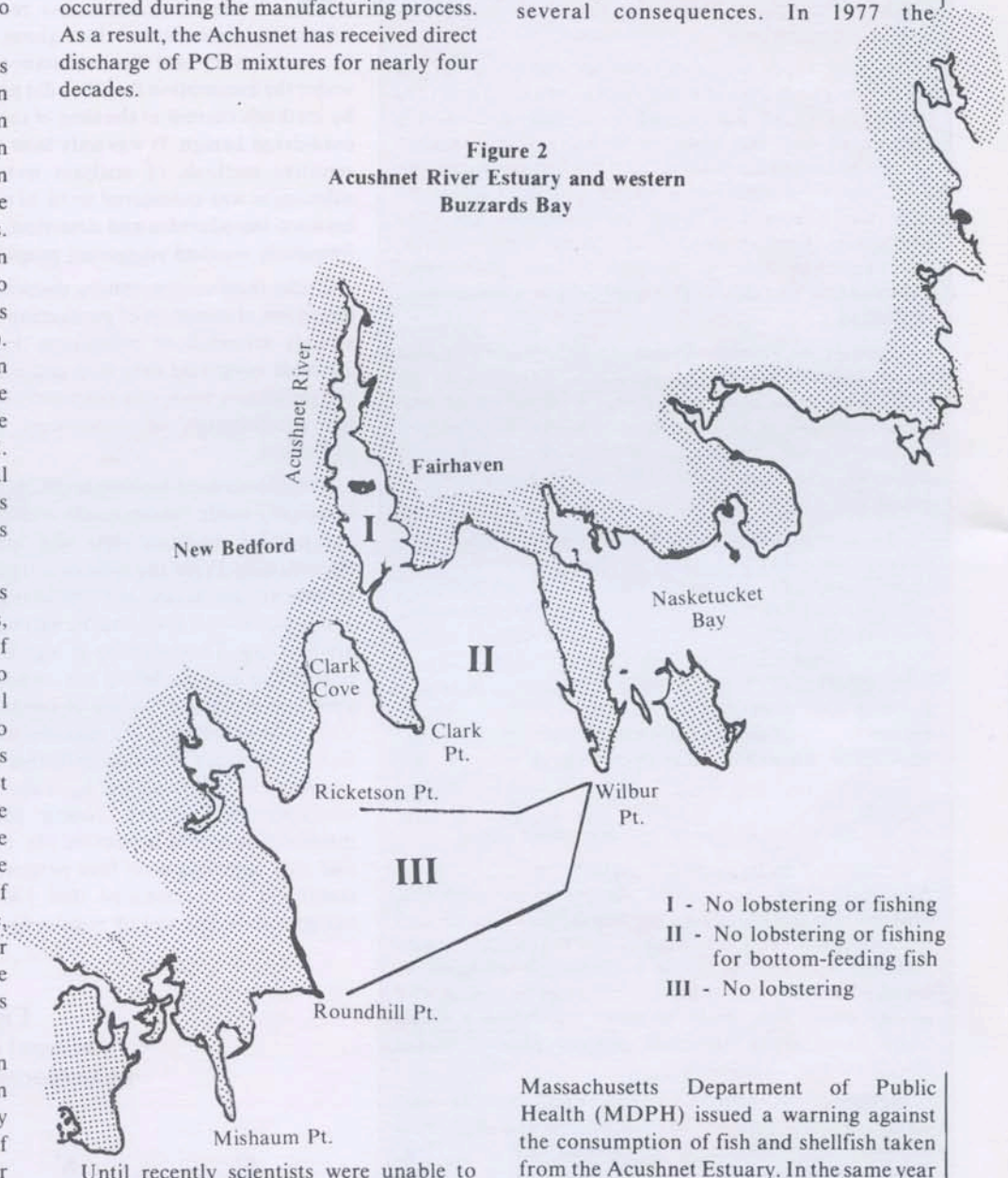
Following the detection of PCB mixtures in environmental samples during the 1960s, Monsanto voluntarily limited its range of PCB products and restricted sales to manufacturers of closed electrical components. Finally, in 1977, Monsanto ceased United States production of PCBs entirely. The cessation of production did not significantly ameliorate the problem since PCBs had already accumulated in the environment as a result of direct discharge and leaching. Since more than one-half of the total PCBs produced are still in service, there remains a great potential for major additions to the environment if effective techniques for neutralizing these substances are not adopted.

Certain geographic areas have been contaminated to a greater degree than others. Coastal areas seem to be especially prominent in this regard due to the siting of both heavy and light industries near waterways. The Hudson River in New York state, whose sediments bear an estimated PCB load of 300,000 kg, is perhaps the best studied example. In the New England region the Acushnet River Estuary bears the dubious distinction of being similarly burdened.

The Acuhsnet, a small river located on the western shore of Buzzards Bay, separates the communities of New Bedford and Fairhaven, Massachusetts. The estuary of this river forms a natural harbor approximately four kilometers (km) long which was responsible for the importance of New Bedford as a commercial port during the nineteenth century. Former textile mills line the banks on the New Bedford side of the estuary. Two of these vacated mills have been occupied by electronic component manufacturers since World War II. PCB mixtures were used by both companies in the manufacture of capacitors and leakage of these substances into the Acushnet River occurred during the manufacturing process. As a result, the Achusnet has received direct discharge of PCB mixtures for nearly four decades.

PCBs were discovered in the Acushnet River in 1974 during analyses of samples for another group of hydrocarbons. Investigators at the Woods Hole Oceanographic Institution (WHOI) found that certain substances, later identified as PCBs, interfered with analytical procedures. Subsequent sampling programs carried out by investigators from WHOI, the Environmental Protection Agency (EPA) and state agencies suggested that the extent of PCB pollution in the estuary was of critical proportions. This information had several consequences. In 1977 the Massachusetts Department of Public Health (MDPH) issued a warning against the consumption of fish and shellfish taken from the Acushnet Estuary. In the same year the two capacitor manufacturers stopped using PCB mixtures. Finally, in 1979, the MDPH expanded its earlier warning by issuing orders which closed the estuary and adjoining portions of Buzzards Bay to fishing (Figure 2). This action was taken because PCB concentrations in fish which inhabited these waters exceeded the federal maximum of five parts per million (ppm) for edible tissue.

Figure 2
Acushnet River Estuary and western Buzzards Bay



Until recently scientists were unable to discern the environmental impact of individual PCB isomers used in mixture forms, since sensitive analytical techniques were not available to detect parts per million (ppm) concentration levels. The advent of high resolution glass-capillary gas chromatography now enables researchers to determine the environmental persistance and toxicity of minute amounts of PCB isomers applied many years ago.

During this time a group of W.H.O.I. scientists had been involved in a nationwide coastal pollution monitoring program named "Mussel Watch" which used the common blue mussel as a sentinel organism. One of this group, Dr. John Farrington, became very concerned about the elevated levels contained in mussels from the Acushnet River Estuary and brought the resources of his laboratory to bear on the problem. As a result, state of the art analyses soon augmented the more routine analytical procedures utilized by the other agencies involved in the problem. This was an important development in that the more sophisticated analytical procedures brought out complexities of the problem which were not detected by standard methods.

The concentration of PCBs in the inner reaches of the Acushnet River Estuary (Area I in Figure 1) is due in part to the presence of a hurricane barrier which was constructed in the mid-1960s. The restricted movement of water and suspended sedimentary particles through the harbor entrance has resulted in the formation of a sink for pollutant compounds which are discharged into the harbor. Consequently, PCB concentrations in the harbor area have reached levels as high as 190,000 ppm near one of the manufacturing plants. Estimates of total PCB load in the harbor, based on several cores and approximately twenty grab samples, indicate that more than 100,000 kg of these pollutants are found within the upper one-half meter of sediment. From the perspective of the health of the Buzzards Bay ecosystem, the formation of this sink might be considered a boon in that the larger fishery has been protected from a potentially major PCB impact for nearly twenty years.

However, the inner harbor sediments cannot be considered a permanent sink for pollutants. A recent study of the distribution of trace metals, another group of pollutants which have accumulated in the harbor over the past eighty years, suggests that the harbor is a "leaky sink" and that some trace metals have been transported on suspended particles of sediment into the western portion of Buzzards Bay. Since PCBs also tend to be associated with solid surfaces, they may be transported in a similar fashion resulting in a chronic but relatively low-level discharge into Buzzards Bay. Analyses of easily resuspended particles in the inner harbor verify this suggestion.

Regardless of the precision involved, scientific research alone may only delineate a problem. The results of the research must be transmitted and explained to those public officials who are responsible for the legal and policy aspects of environmental management. Frequently, this transfer of information from generator to eventual user is not as direct as might be supposed. This seems to be especially true when the generator is an independent academic laboratory desiring collaboration with agencies which may have proprietary interests in the matter. This particular problem was brought closer to resolution as a result of the formation, in 1979, of the Ad Hoc Committee by State Representative Roger Goyette of New Bedford. Periodic meetings of this committee increased the general awareness of the PCB problem within the various agencies of the Commonwealth and on the national level.

Sufficient data now exists which indicates that PCB mixtures have an adverse effect on biological systems.

It soon became obvious that attention to this problem was required since estimates of the costs of dredging operations approached 130 million dollars. Such a sum could not easily be assimilated by either local or state resources during these current fiscally straitened times. In 1982 the Acushnet River Estuary was added to the list of U.S. EPA hazardous waste sites making it thereby eligible for "Superfund" assistance. At the present time additional data on various aspects of the problem are being generated in order to better define the problem and to design an appropriate solution.

One of the solutions being considered is a dredging of the harbor sediments to a depth of one-half meter. Of the various management alternatives, dredging appears to be the most technically and economically feasible method to alleviate the problem in the near future. However, even under ideal conditions, dredging operations can only account for a capture of approximately ninety percent of the sediments. The remainder escapes as a result of the resuspension of particles disturbed during dredging. These particles will settle at velocities dependent on their diameter resulting in a prolonged suspension of fine-grained particles. In a suspended state these particles are subject to transport out of the harbor and into Buzzards Bay.

The specific cause for concern relates to the high surface area-to-volume ratio of fine particules relative to coarser ones. Higher concentrations of PCBs should therefore be associated with the fine particulate fraction of the sediment. A hypothesized consequence of this relationship should be a considerable net transport of PCBs into Buzzards Bay during dredging operations. We are currently attempting to define the PCB-to-particle size relationship at Bridgewater State College using funds provided for this purpose by the Pappas Foundation of West Falmouth, Massachusetts.

Particle size analyses of the twelve stations sampled indicate that nearly one-third of the sediment is finer than medium silt. Assuming an average water depth of five meters and absolutely calm conditions, these particles would stay in suspension for a minimum of seven hours. An even more alarming consequence is that under the same conditions nearly one-sixth of the sediment which escapes capture would remain suspended in the water column for over four days. During this time it would be subject to, at minimum, transport by eight tidal cycles.

Though the above are preliminary order of magnitude calculations, they do suggest that even just the removal of affected sediments is not as simple a procedure as might be expected. When other factors such as disposal of the captured sediment are considered, it becomes obvious that quick solutions to the problem are not forthcoming and that alternatives should be based on well considered research.

Considering the foregoing, the no-action alternative might seem attractive. However, in the long term this alternative has serious consequences. The hurricane barrier which has provided a measure of protection to the Buzzards Bay ecosystem has never been tested by a major storm. It is possible to envision a scenario in which a hurricane overtops the barrier and transports the polluted sediments into Buzzards Bay. Under these circumstances a problem which was once localized and potentially soluble becomes unmanageable as a result of inaction.

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