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Bringing Back the Bay: The Role of Science in Making Policy

"Our society is awash in politicized science; very often the public recognizes it and distrusts research, scientists, and associated organizations because of it" (Kenner 1998). Brian Kenner, who warns against the politicizing of science, joins other thinkers and researchers who argue that moneyed interests often "shape the framing and resolution of issues, including the conduct of scientific research" (Jasanoff 1997). In the words of David Orr, "The politicization of science has become a growth industry ... undermining good science and sound public policy in the cause of exploitation" (1994, 122).

"Science is not helping," according to C. S. Holling, "largely because there are not only conflicting voices but conflicting modes of inquiry and criteria for establishing the credibility of a line of argument" (Gunderson 1995). Some take a particularly cynical view, arguing, for example, that oceanographers in the United States should be seen as an "elite labor force" operating essentially for the state, while enjoying the "illusion of autonomy" (Mukerji 1989).

And yet others argue that without sound science our efforts to manage a system as complex as the Chesapeake Bay will prove fruitless. "As a nation with a reawakening concern about the quality of the environment, we must strive to ensure that the most current and best techniques are applied under the best possible conceptual framework or we will make little long-term progress in environmental management" (D'Elia 1989).

In the large-scale federal–state partnership known as the Chesapeake Bay Program, scientists and scientific research have unquestionably played a key role in shaping management, though the relationship between science and policy has often been as complex as the estuary itself. On the one hand, researchers have at times played the role of pushing the policy envelope, complaining, for example, that "officials ... seem compelled to de-emphasize scientific evidence that might imply the need to adopt some unattractive (to them) course of action, such as nitrogen removal..." (D'Elia 1987).

On the other hand, scientific evidence or scientific uncertainty is sometimes used to slow environmental policies: thinkers like David Orr complain, for example, that scientists too often suffer from a "hyperobjectivity" that interferes with their function as caring human beings (Orr 1994). We recall, too, that Aldo Leopold at times rejected the cold rationality of science: "We are not scientists," he said. "We disqualify ourselves at the outset by professing loyalty to and affection for a thing: wildlife." (Leopold [1941] 1991). Leopold goes on to say that "[t]he definitions of science written by, let us say, the National Academy, deal almost exclusively with the creation and exercise of power" (p. 276).

Working in the inevitable context of influence and power, have scientists studying the Chesapeake Bay been able to maintain their relative objectivity, while at the same time contributing to the restoration of this treasured resource? How has science influenced policy-making in the Chesapeake? What factors have brought scientific rigor and caring for the environment together in the interest of a common goal?

Early Warnings

If, as I will argue, scientific findings have come to steer many of our most important efforts to save the ecological health of the Chesapeake Bay, this was clearly not always the case. Consider, for example, the Bay's oyster industry, which once produced more meat in the region than beef cattle and provided the economic backbone for bayside communities in Maryland and Virginia. In the case of the oyster, scientific warnings came loudly at the end of the nineteenth century, most notably from William K. Brooks, a Johns Hopkins University professor and devoted student of the oyster. "Proud as our citizens once were of our birthright in our oyster-beds," said Brooks a century ago, "we will be unable to give to our children any remnant of our patrimony unless the whole oyster industry is reformed without delay" (Brooks [1891] 1996). Brooks's judgment was harsh: "We have wasted our inheritance by improvidence and mismanagement and blind confidence..." (p. 3).

As researcher Kennedy Paynter points out, the oyster population in the Chesapeake Bay is now estimated to be "at its lowest level in recorded history" (Paynter, in Brooks [1891] 1996). Despite Brooks's pleas, Maryland and Virginia proved unable to turn the tide on the bivalve's demise. Decade after decade of overharvesting, habitat destruction, and disease soon decimated what were once among the richest natural oyster bars in the world.

One could argue that here the science was not difficult: the looming collapse of the Bay's oyster stocks was perhaps visible to many. What was missing was a "sustaining and supporting social order" needed to "reassure skeptical publics and serve as a compelling basis for policy decisions" (Jasanoff 1995).

Lacking the social consensus necessary to make difficult decisions, science failed to alter the

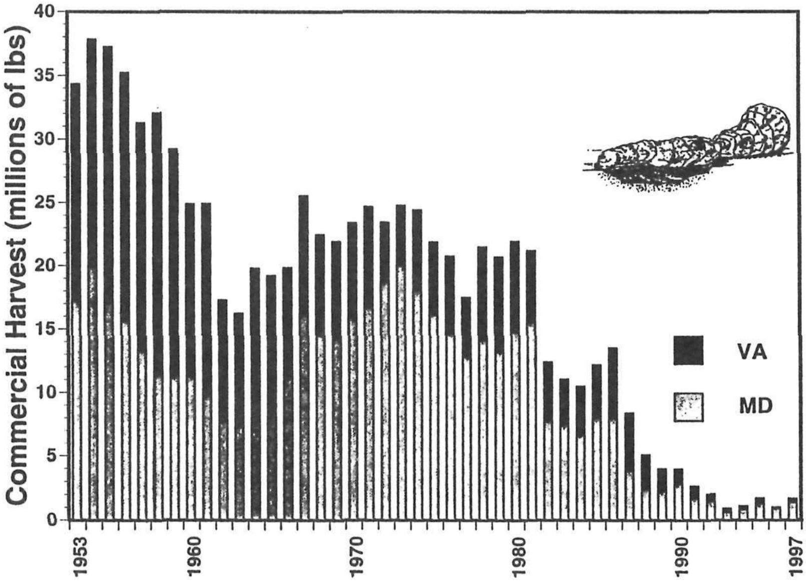


Figure 13. Commercial oyster harvests, 1953-1997.

course of the Chesapeake oyster's long and catastrophic decline. According to current research (Newell 1988; 1997), the catastrophe has had ecological as well as economic consequences. Since oyster reefs serve as prodigious "filters" of algae—algae now superabundant in the Bay—their disappearance has meant a double jeopardy. Just as the Bay started to receive increased nutrient loads from a watershed cleared for agriculture and development, humans inadvertently began to remove what may have been the very best mechanism for helping to control excess algae fueled by nutrients: the long white rows of oyster reefs that once lined the shallow sides of the Chesapeake.

While science—joined with aggressive restoration programs—now probably offers the best hope of restoring the oyster fishery, especially through research on two devastating oyster diseases (Leffler 1998), it is clear that science, even with a prophet as passionate as William Brooks, was not enough to turn the tide for the Bay's oyster bars.

The Emergence of Ecology-Based Policy

In Sheila Jasanoff's words, "The question before us is not how to produce the 'best' possible science for policy, a problem definition that falsely presupposes the autonomy of scientific inquiry. Rather we must ask how to achieve the moral certainty needed for real-time decisions." She calls for a science that achieves "moral as well as epistemological authority" (1997, 232).

In the Chesapeake Bay, science has found a powerful social context in which to "speak truth to power," a context defined by a strong moral imperative put forward by politicians such as Maryland State Senator Bernie Fowler and Virginia State Senator Joe Gartland, and influential writers such as William Warner and Tom Horton, who have articulated for many a strong affection and concern for the Chesapeake.

According to Robert Costanza, the recent management of the Chesapeake Bay has moved through three distinct periods:

- 1965 - 1976: An era of shared experience and raised consciousness.
- 1977 - 1983: An era of intense scientific analysis with political backing.
- 1983 - present: An era of implementation and monitoring.

In Costanza's view, this management has evolved to deal fairly successfully with "point-source" issues, such as industrial outfalls and waste treatment plants. It is now, he suggests, "primed" to deal with difficult nonpoint issues, including agriculture and stormwater run-off (1995, 200).

Several important factors have made possible this move from "raised consciousness" to "scientific analysis" to "implementation." The first was the expression of public concern. The Bay's protected and abundant waters drew human interest early on, but during the 1960s, residents in the Bay region began to realize that the Bay's remarkable biological productivity—an abundance they had too often taken for granted—was beginning to decline. In that same decade, concerned citizens formed the Chesapeake Bay Foundation, an advocacy and educational group that now boasts more than 80,000 members.

In 1976, William Warner published *Beautiful Swimmers,* an evocative and compelling depiction of the Bay blue crab and those who make their living catching it. *Beautiful Swimmers* galvanized interest and concern for the Bay, and when it won the Pulitzer Prize, it attracted attention from far beyond Bay country. At the same time, and especially during the 1980s, Tom Horton was reporting on the Bay through insightful and incisive articles for the *Baltimore Sun* and then in several popular books on the Bay, further raising public awareness, understanding, and concern.

Concurrent with this, and no doubt arising from it, a large multistate and federal initiative soon began, one that would depend squarely on the scientific work carried out by

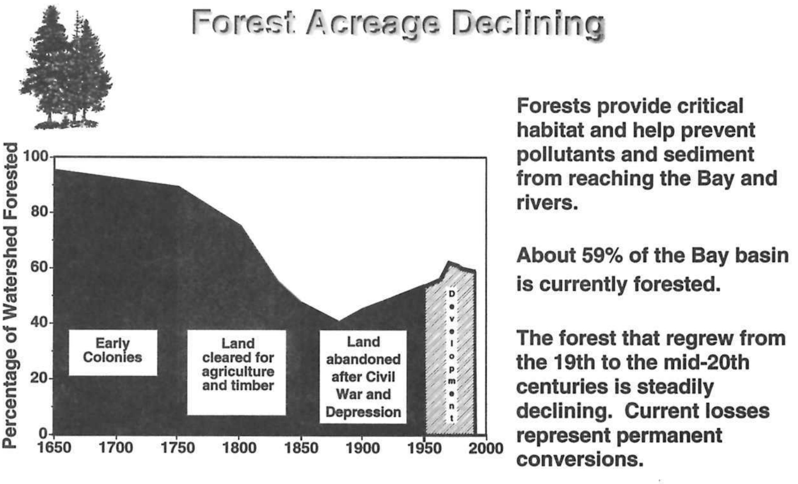


Figure 14. Forested acreage in the Chesapeake Bay watershed, 1650-2000

a group of dedicated researchers, researchers who had themselves often been long-term residents and observers of the Bay.

The federal initiative—and much of the scientific work—found its support and focus through the U.S. Congress, and perhaps most specifically through Senator Charles "Mac" Mathias of Maryland. Mathias was hearing from his constituents that this mother of estuaries, a central feature of his home state, was ailing. In 1973, he took, with his family, what has become a historic trip around the Bay to see for himself and to hear directly from watermen and other citizens. By the end of the trip, he determined that things were indeed bad, and that something had to be done on a large scale.

Mathias recalls that he also turned to scientists like Eugene Cronin, then head of the University of Maryland's Chesapeake Biological Laboratory, for advice and guidance. Researchers thus found themselves in a position to influence public policy, as politicians rallied to support a comprehensive scientific study of the Chesapeake. This cooperation was unusual. On the one hand, the Bay did not suffer from acute chemical contamination—with a few notable exceptions, such as contamination in Norfolk and Baltimore harbors or the spill of the pesticide Kepone into the James River that would occur in the 1980s. In general, and unlike, say, Love Canal, threats to human health were not apparent.

On the other hand, politicians found themselves facing a powerful public wave of anger and concern. "I was amazed," said Maryland Governor Harry Hughes, "to see how passionate people were about the Bay no matter where I went in the state" (personal communication, 1998). What Hughes and other political leaders could not foresee were the conclusions that scientific research would suggest—conclusions that would point the way toward a whole new policy regime.

Stemming the Tide

"We all thought it was going to be Bethlehem Steel," Senator Mathias recalled at one point, reflecting the popular sentiment held by many around the Bay that big industry, with its smoke stacks and foul pipes, had caused the demise of the Chesapeake. Meanwhile, researchers at the University of Maryland Center of Environmental Science (UMCES, both the Chesapeake Biological Laboratory and the Horn Point Laboratory), the Virginia Institute of Marine Science, the Smithsonian Environmental Research Laboratory, the Academy of Natural Sciences Estuarine Research Center, and elsewhere were on the trail of other possible culprits, including agriculture—many of them working with EPA funds, thanks to Mathias and the federal government.

One of the key mysteries facing scientists was the catastrophic disappearance of underwater grasses, an important part of the Bay's bottom-dwelling (or benthic) ecosystem. Clearly, Tropical Storm Agnes had in 1972 scoured many of the grasses with its heavy punch of sediment and fresh water, but why didn't the grasses come back as a year and then another and then another passed? And why had so many species of grass disappeared all through the Bay, even in southern tributaries like the York River, far from the flooding Susquehanna?

"We thought it was herbicides," remembers Walter Boynton, a researcher at UMCES. Boynton and his colleagues could see from aerial maps that underwater grasses were disappearing not just near the big cities and industrial harbors like Baltimore and Norfolk, but all around the Bay, even in remote areas of the Eastern Shore. While there was little industry in many of these outlying areas, there was another active enterprise: agriculture. And since World War II the use of weed killers—herbicides—had grown exponentially, especially with such practices as no-till farming, developed to reduce plowing and therefore prevent unnecessary loss of soil, but also heavily reliant on herbicides.

After several years of research in the late 1970s and early 1980s, however, data did not point to herbicides as the cause of the great sea grass die-off. These chemicals could potentially damage the grasses, especially in confined, near-shore areas and coves, but levels did not appear high enough in the open waters to cause the kind of wholesale disappearance of grass beds that had occurred up and down the Bay (Orth et al. 1986).

What the researchers found next would have a profound effect on policy and on the course of the Chesapeake Bay Program.

Boynton tells it best. "I had a graduate student," he says, "who kept coming up to ask, 'What is this slime on the grass blades?' I told him not to bother me, that we were trying to figure out what was killing the grasses" (personal communication, 1989). Of course, it turned out that the "slime" was a key clue to the sea grass die-off. Like a final, fatal blow, nutrients not only fueled the growth of algae that clouded the Bay's waters, but they also encouraged the growth of tiny plants—epiphytes—that flourished on the blades of the underwater grasses, covering them with a glove of "slime" and further blocking out the light.

The diagnosis: the Chesapeake Bay was dying from a lack of light. The causative agent: nutrients, not only phosphorus, but, as argued by scientists like Christopher D'Elia and James Sanders, nitrogen—a nutrient much more difficult to contain. (D'Elia 1987).

The New Dispensation

When scientific findings were announced at a Baywide conference in 1983, policy makers had the ammunition they needed to initiate a large-scale, multi-jurisdictional restoration program, and with the signing of the first Chesapeake Bay Agreement the Chesapeake Bay Program was born.

But the Chesapeake Bay is not a national park or protected area, and controlling Bay uses (and abuses) presents a daunting task. Even areas established as "estuarine research reserves" have encountered considerable resistance when authorities have attempted to limit use of public waters—as resource managers found, for example, when they tried to limit water-skiing on Maryland's Rhode River. To affect large-scale policies in the Bay region—that is, to influence large-scale legislative and regulatory change—resource managers and conservationists needed powerful arguments capable of swaying public (and therefore legislative) opinion. Those arguments relied heavily on the research results that emanated from a five-to-six-year, $27 million study, funded by the Environmental Protection Agency.

Was science co-opted by political pressures? The answer must be a resounding, "No." Early work on nitrogen, for example, caused problems for regulators, resource managers, and political leaders because it suggested that the states would need to undertake expensive nitrogen removal in the watershed's waste treatment plants. Despite some wrangling, the science stood, and biological nutrient removal is now a cornerstone of the Baywide control of point sources of nitrogen.

In fact, the Bay Program has at times gone out of its way to acknowledge the uncertainty principle, careful not to overlook potential threats, even when scientific evidence remains mixed. Some researchers, for example, recommended removing Atrazine, at times the most widely used herbicide in the watershed, from the Bay's Toxics of Concern List, based on studies that failed to find damaging concentrations. When a scientific review suggested that uncertainty remained, the Bay Program decided, at least for now, to keep Atrazine on the list.

With the emergence of a new environmental threat, *Pfiesteria piscicida,* the research and management communities face yet another area of uncertainty. In the late 1980s aquatic botanist JoAnn Burkholder at North Carolina State University discovered and named, along with her colleagues and taxonomist Karen Steidinger, a new toxic dinoflagellate, which they called *Pfiesteria* after the well-known aquatic botanist Lois Pfiester. The name *piscicida* means "fish killer," and was chosen because extensive evidence, both in the laboratory and in the open water, suggests that this tiny marine organism, not much larger than a bacterium, can kill fish with powerful toxins.

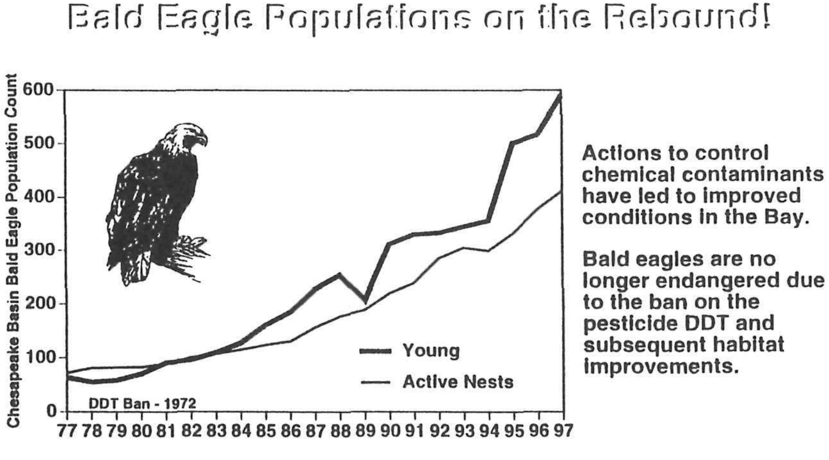


Figure 15. Chesapeake Basin bald eagle population, 1977-1997

Pfiesteria, which also appears to sicken people (Morris 1998), has made not only regional but national and international news. Early on, many observers linked outbreaks of *Pfiesteria* with pollution, especially run-off from hog or chicken farms, but scientists are still scrambling to make connections between causes and effects, between run-off from the land and other physical, chemical, and environmental factors and outbreaks of this noxious algae.

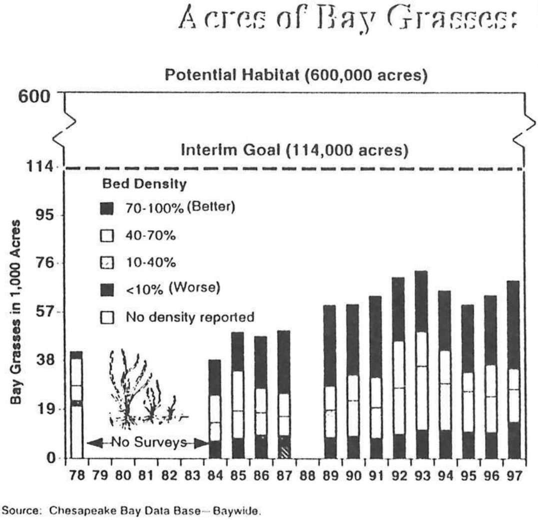
Alan Lewitus, who, with his colleagues, first found *Pfiesteria* in the Chesapeake Bay (in 1992), says that he discovered it near the Horn Point Laboratory where he then worked, "in the first place I looked" (personal communication, 1998). To find a marine organism that measures no more than 10 microns the first time you look for it suggests that it must be at least relatively abundant.

Most likely, suggest researchers like Donald Boesch, Christopher D'Elia, and others who have studied coastal ecosystems like the Bay, *Pfiesteria* has been around for quite a long time. In the words of one waterman, it has probably been here since "the dawn of time." The question, of course, is why has it suddenly become so virulent?

To answer that question means not only launching a new line of inquiry into the behavior of a novel "ambush predator," but continuing a line of scientific work that has been underway for decades. Just as earlier work helped document how something as benign as nutrients could cause the demise of vast areas of underwater grass, so current work will reveal to us exactly how a highly productive estuary like the Chesapeake Bay responds to shifts in climate, land use, and other factors to produce its remarkable food web, a food web that includes microscopic organisms we have not yet even named.

The roles of phosphorus and nitrogen (especially organic forms such as urea), already of interest, are being re-examined largely because of *Pfiesteria.* Whether environmental changes resulting from nutrients are the immediate cause for *Pfiesteria* outbreaks remain to be confirmed, though considerable circumstantial evidence exists to suggest a link (Boesch 1997). With powerful interest from the environmental community on the one hand and large-scale nutrient producers such as agribusiness on the other, the challenge to the Bay's research community remains serious.

So far, the role of science, thanks to the work of a dedicated, highly sophisticated cadre of researchers, has proven pivotal in the current effort to restore the Chesapeake Bay. In fact, awards are now given to scientists for their contributions to research in the interest of public policy, such as the Mathias Medal, named for Senator Mathias and awarded by the Sea Grant Programs of Maryland and Virginia, and by the Chesapeake Research Consortium.



GOAL: The interim goal is to restore Bay grasses to all areas where they were mapped from 1971 -1990.

STATUS: The percentage of higher density beds (70-100%) was about 50% in 1997, compared to 37% in 1984. The highest percentage of higher density beds was observed in 1989 when it was 53%.

Figure 16. Density of Chesapeake Bay grass beds, 1978-1997

Nevertheless, despite the direct impact of science on Bay-related policies, many still underestimate (and misunderstand) the value of research. Some politicians, for example, after the conclusion of the initial Chesapeake Bay Study, said, verbatim, "We've had enough research. Now we need action."

Clearly, if we are to restore the Chesapeake Bay to anything approaching its historic health and productivity, we need to take action; but without research, we will never be certain of what actions to take. The recent blooms of *Pfiesteria* and other potentially harmful algae in several Chesapeake Bay tributaries reinforce this point. What we need, to take E. O. Wilson's word, is "consilience," the joining together of knowledge from many different disciplines (Wilson 1998)—in this case to solve complicated environmental problems. In the Chesapeake we have clearly had a group of dedicated individuals with diverse backgrounds in chemistry, biology, geology, physics, and other fields, all of whom have come together to pool their knowledge in an attempt to determine how we might restore what was once the nation's richest estuary.

It is devoutly to be hoped that our leaders will no longer claim that "we've had enough research," but will understand that ongoing scientific inquiry presents our only hope of understanding what is happening to the Chesapeake Bay and other of America's rich ecosystems. At the same time, it will be important to avoid the "hyperobjectivity" David Orr refers to.

In the Chesapeake Bay, it is fair to say that a passionate concern has in fact joined with intense scientific inquiry to help address many pressing policy issues. We must applaud a circle of scientists who care, recognizing at the same time how science actually works: that despite our committees, our strategic plans and integrated programs, it is often the free-ranging individual intellect that leads us to new discoveries. As C. S. Holling argues, the management of ecosystems runs into problems when people forget "that all policies are experimental." Holling calls for investments in "eclectic science, not just in controlled science" (1995, 9). We must always be willing to listen to the graduate student who approaches us, squinting in the sun, asking, "What is this slime?"

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