

Fish Or Foul: A History of the Delaware River Basin Through the Perspective of the American Shad, 1682 to the Present

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The Delaware River system drains less than one percent of the landmass of the continental United States, but it has been long one of the most densely populated and heavily industrialized regions in the nation, boasting the world's largest concentration of chemical companies and the nation's second largest concentration of petrochemical plants. As a result, the Delaware River watershed has been subjected to extremely heavy use and undergone revolutionary, and from an environmental perspective, catastrophic changes. Once home to an extraordinary profusion of wildlife, the region under Euro-American occupancy has experienced an ecological catastrophe, with the disappearance of species once numbering in the millions.

This article attempts to document the history of the Delaware River system through the perspective of its most important finfishery, that of the American shad. Shad is a wonderful species by which to trace this history. First of the migratory species to appear in the rivers each spring, shad, unlike other anadromous species such as salmon, is remarkably hardy and adaptable. This has enabled it to survive a series of human assaults and challenges to its survival in the region. It also makes it possible for the historian to use the shad as a means to examine the interrelationships over time of economic development, law, public health, resource management, American foodways, the environment, and culture; that is, the meaning of shad to residents of the Delaware River basin as well as its utility.

Overview and Periodization

The history of the American shad since the arrival of European settlers to the Delaware Basin region can be divided into five distinctive periods. First came the colonial open-river fishery, when the shad provided residents of the region one of their most important food sources. A second phase began in the 1820s when economic development and the construction of canals and dams along the Delaware and its tributaries increased the volume of commerce. By 1830 dams had ended many of the open-river fisheries, blocking the shad access to over eighty percent of its natural spawning grounds. This second period also witnessed the growth of a thriving commercial shad fishery along the banks of the Delaware River which provided shad to growing urban markets. Overfishing in an already constricted river system destroyed the antebellum shad fishery in the 1840s and ended the second phase.

The third phase begins in the 1870s with the establishment of state and federal fish commissions to study the nation's declining food fish industries, followed by the rapid resource exploitation and development in the 1880s and 1890s of the Delaware as the nation's most productive commercial shad fishery. Also during this period, shad became a cultural artifact, its fisheries photographed and painted by Thomas Eakins, its flesh and roe enshrined in the haute cuisine of the region's social elite.

The shad boom of the 1880s and 1890s proved as short-lived as its antebellum predecessor. Transition from the third to fourth phase took place in the early twentieth century. Overfishing and water pollution all but eliminated shad from the river, as human and industrial wastes converted the Delaware into one of the nation's most polluted waterways. During this dark chapter of the river's history local authorities and biologists began to identify shad as the most important single biological indicator of water quality.

The fifth and most recent phase of the shad fishery began in the 1940s with the establishment of new regional and federal mechanisms to address the problems of water quality and pollution control. Steady improvements in water quality from the early 1950s to the present brought the shad back to the river, spurring the growth of a major sportfishery that today attracts more than 40,000 anglers to the river each spring. Today coalitions of sportfishermen, environmentalists, and those interested in developing the region's recreational potential have teamed together to form a powerful lobby for river cleanup and protection.

Phase One: The Colonial Open-River Fishery

The Delaware River is the main stem of a geologically old and complex river system whose major branches include the Schuylkill, Lehigh, and Brandywine in Pennsylvania and Delaware, and the Neversink and East Branch in New York. This watershed extends from the headwaters of the Delaware River near the town of Woodchuck in New York's Catskill Mountain 336 miles south to the mouth of the Delaware Bay. Together the Delaware and its tributaries drain an area of 13,500 square miles of anywhere from one to five and one-half trillion gallons of water each year. The river itself can be divided into two major zones. The upper river extends from the headwaters near Hancock, New York, to the fall line near Trenton, New Jersey, flowing down through a hard rock of piedmont that rises above the coastal plain. Below the fall line the lower river broadens. Just south of Philadelphia ocean tides mix fresh and salt water in the lower river and bay. Like all estuaries, this was once an extraordinarily rich ecological region.¹

A lavish abundance of air-born, terrestrial, and aquatic wildlife astonished early explorers and settlers to the region. The Delaware River and Bay were home to more than three hundred species of fish, including great num-

bers of catfish, lamprey, eel, trout, smelt, and sunfish which were joined by the occasional whale swimming into the fresh water sections of the river. Charting the river in the winter of 1632-33, Dutch explorer David De Vries wrote of waters so filled with fish that one drop of a seine net caught as many perch, roach, and pike as thirty men could eat in a day. William Penn was equally expansive about the natural abundance of the region, writing of oysters so large that they required division before entering one's mouth, and of sturgeon that leapt into the air in such numbers that they endangered small skiffs. Early settlers wrote of aloe so plentiful that a single dip of the net could pull in 600; herring that ran in shoals so thick that colonists could almost shovel them into their tubs; rockfish so abundant they could be barreled like cod.²

The fish that most impressed the early colonists was the shad, which for millennia had spawned in rivers all along the Atlantic Coast, from St. John's River in south Florida all the way north to the Gulf of St. Lawrence in Canada. The largest member of the herring family, the American shad is an elongated slab-sided fish that at maturity can reach twelve to thirteen pounds. Planctonic feeders, shad swim in great schools along the coastal waters of the Atlantic Ocean, their mouths opened wide as they feed on plankton carried in the ocean currents. Each spring, as the water temperatures warm, the shad move inshore and migrate to their native streams to spawn. They remain in the rivers until the fall, when the survivors of the previous spring migration join millions of shad fry and fingerlings in a down-river migration back to the ocean.

The wildlife of the Delaware River basin ebbed and waned with the seasons. As the first English settlers in Jamestown and Plymouth had discovered only after the loss of many lives, game and fish could become dangerously scarce during the winter months. Confronted by famine and starvation in the early years of settlement, the colonists, as the Indians before them, learned to preserve and husband food sources for the long winters. For human purposes anadromous species such as salmon and shad are by far the most important finfish. A migratory fish run concentrates a huge biological mass from the vast expanse of an ocean into a narrow geographical zone. Arriving in late March or early April, shad were one of the first food sources to relieve the shortages of the preceding winter. Indeed, Nathan Hale asserted that it was an uncommonly early run of the shad in the spring of 1778 that saved Washington and his troops camped in Valley Forge!³

Fish, historically, have been a significant source of animal protein for the world's poor. So, too, they provided a cheap and nutritious food for the Delaware River basin's residents. Indians of the Mid-Atlantic region were skilled and resourceful fishermen who employed a wide variety of weirs, traps, scoop nets, spears, bows and arrows, gigs, hand poles, and other ingenious contrivances to capture their prey. Colonists quickly learned from the Indians how to

catch and preserve shad for use during lean winter months. Shad quickly became the region's most important finfishery, the annual spring runs providing a considerable proportion of many river dwellers' annual incomes. Each spring people from the surrounding countryside would travel to the banks of the rivers, bartering maple syrup, cider, whiskey, tanned leather, iron, salt—always valuable and in high demand for the salting of the fish—or whatever else they had of marketable value, to acquire their winter supply of shad. According to fisheries historian William H. Meehan, every frontier homestead and rural farm had its half barrel of salted shad sitting in the kitchen, with some choice pieces of smoked shad hanging by the kitchen chimney.⁴

Prime fishing locations along the banks of the Delaware and its tributaries quickly became the sites of valuable shore fisheries, especially those near major population centers such as Philadelphia, where shad played as important a part in the local foodways as in the back country. The Philadelphia shad industry centered on the Schuylkill River which, flowing peacefully past the unsettled western edge of the city, was narrow enough to be easily spanned by nets and weirs. Rock outcroppings into the river at the town of Manayunk and on a cluster of islands below the present Fairmount Dam became the site of important shore fisheries. Indeed, Schuylkill fishing rights became so highly prized that fishermen paid good prices for a single cast of a hoopnet.⁵

The superabundance of fish made the shad a logical commodity for export. William Penn won from the Crown the right to import salt to Philadelphia duty free, hoping to develop an export fishery. To this same end the Pennsylvania assembly passed legislation to develop fisheries on the Susquehanna, Delaware, and Lehigh Rivers. But Pennsylvania never did develop an export fishery. Both the English and the New England colonials preferred cod and other species with fewer bones, and a better taste when dried and salted.⁶

This contempt for shad, however, never penetrated Pennsylvania, where demand grew steadily. Aggressive competition for fishing rights, wasteful harvesting techniques, and an ideology that assumed the bounty of nature to be inexhaustible led within thirty years of English settlement to a serious decline in the numbers of fish reaching upriver settlements. By the 1720s Pennsylvanians were already squabbling over rights to the Schuylkill fisheries, which supplied what many considered the region's best-tasting shad. To maximize their catches, Schuylkill fishermen constructed racks that stretched across the river and barred the fish their passage upriver. Although this system of harvesting was very efficient, it was so wasteful that in May, 1724, the Pennsylvania assembly passed a bill requiring demolition of the fish racks and dams that were depleting this valuable migratory fish. When settlers at Long Ford—near present-day Valley Forge—ignored the act, the assembly in 1730 passed a second act prohibiting the erection of new fish racks.⁷

Eight years later the continuing tensions among upriver communities over fishing rights turned violent. At Long Ford, the major shad fishery upstream of Manayunk, local residents fenced the stream and dug out deep pools into which they herded the shad, capturing tens of thousands which they then salted and marketed to the surrounding areas for winter use. Few fish made it above the Long Ford fences and dams, to the dismay of upstream residents. When the Long Ford fishermen constructed their dams and weirs on the Schuylkill in April and May 1738, a small flotilla of outraged upriver fishermen floated downstream to cut the fences only to be driven off by the angry Valley Forgers. The warring parties finally reached a compromise agreement in which the Valley Forgers agreed to keep the fences far enough below the surface to allow upriver navigation, and to open them after a certain amount of time so that shad could pass through to the upriver communities. According to Meehan, the Long Ford fishing war of 1738 not only ended rack fishing on the Schuylkill but also helped transform what had been a seasonal pursuit conducted by the whole neighborhood into the avocation of a handful of professional fishermen. The dispute also highlighted the need to assign rights to manage and preserve the regional shad fishery. The adjudication of fishery disputes would continue to occupy the attention of colonial, then state authorities for the next two hundred years.

Before the advent of the railroad, rivers were the nation's primary arteries of inland commerce and transportation. River boats, barges, and makeshift rafts carrying lumber, produce, and other commodities to market had to traverse a succession of rapids, falls, and shallows impassable during large parts of the year. First the colonies and then the independent states invested tremendous amounts of money and effort into improving navigation on their waterways, for economic development depended upon navigable waterways, which in turn required the construction of a network of diversions, channels, canals, wing dams and dams that would span the full width of a river. The Schuylkill River was the first major tributary in the Delaware system to be extensively dammed. The discovery of coal and iron ore in the Lehigh Valley necessitated the construction of an elaborate system of canals and dams along both Schuylkill and Lehigh Rivers in order to move the coal more efficiently to market. Incorporated in 1815, the Schuylkill Navigation Company in less than a decade built two dams across the Schuylkill River at Shawmont and Reading and opened a canal to the Lehigh coal fields. Such intenal improvements cut the cost of shipping coal to Philadelphia from \$28 to \$3 a ton. Soon a network of canals also linked the Lehigh coal to New York and towns in both northern and central New Jersey.⁸

Phase Two: The Ante-bellum Fishery

A canal and dam building boom in the 1820s and 1830s stimulated regional economic development, but it also drastically curtailed the ranges of migratory fish all along the East Coast, cutting them off from major stretches of primary spawning grounds. At the beginning of the canal construction boom, states bordering the Delaware and its tributaries continued to recognize the legitimate rights and interests of both fishermen and developers. In Pennsylvania, for example, fishermen won a number of court suits which forced the Schuylkill Navigation Company to pay heavy fines for blocking the shad's upriver migration. But fishermen's legal rights on the Delaware's tributaries collapsed in 1822 when the city of Philadelphia's pressing need for more potable water led to the damming of the lower Schuylkill and ended the great shad runs on the Schuylkill River. The damming of the Schuylkill immediately stimulated development of the shore fisheries on the main stem of the Delaware.

Unlike the Schuylkill, the Delaware was too large to span with a single net. Down-river fishermen's inability to block the shad's upriver migration not only ensured survival of the fish in the upper river but also provided opportunities for the establishment of profitable shore fisheries along the Delaware's full length. The closing of the Schuylkill just as Philadelphia's population was entering a period of unprecedented growth transformed the Delaware shad fishery into an important regional industry. Long a major source of animal protein for urban dwellers, shad continued to occupy a prominent place in the region's foodways.

Shad also had cultural significance as a marker of the return of warm weather. Each spring Philadelphians would listen for the cries of street vendors announcing that shad was again in the market. The sight of hucksters and peddlers filling their carts and wagons as they met the shad boats at the shore was a common sight on the major market days, as were the women who peddled fish through the streets of the city from baskets carried on their heads. Local artists and writers celebrated images of fish women and oyster shuckers as a cherished aspect of Philadelphia life. During the 1830s enterprising free blacks in Philadelphia, some of them from French Saint Domingue (Haiti), began to establish themselves as prized cooks and caterers, building a unique Philadelphia haute cuisine around inexpensive seafoods, including terrapin, oysters, and shad. Shad in the early nineteenth century, then, was changing its meaning, gaining increased respectability and status.⁹

The increased demand for shad also led to the use of more efficient techniques of harvesting, restructuring of the commercial fishery, and Delaware fishing wars. Carrying on a traditional way of life that dated back centuries, most Delaware River fishermen operated their shore fisheries in common, shares distributed in accordance with formulas brought over by the first

European colonists. Fishing families spent long winter nights hand-braiding nets which they knit in sections each spring, each shareholder receiving a share of fish in proportion to the number of yards owned. With fishing rights linked to the ownership or lease of shorefront properties, shad were fished from the shore in large seine nets, each of which required five to seven men to manage. The majority of ante-bellum shore fisheries held onto these traditional arrangements and fishing techniques, but a number of larger shore fisheries emerged near Philadelphia that took on more modern capitalist forms of organization.

The shad boom of the early nineteenth century drove up rents for prime shorefront fishing locations and led to the organization of highly capitalized, private commercial ventures which paid workers in wages rather than shares. One of the larger of these new proprietary ventures was the Fancy Hills fishery, located six miles below Philadelphia, which supplied shad for the city market. By the mid-1830s Fancy Hill employed nearly 100 men. Using a large, shore-mounted capstan to haul in the heavy cotton nets, Fancy Hill filled 60 to 70 wagons a day during the height of the spring runs, each wagon carrying approximately 100 fish. By the 1840s two dozen large fisheries on the Delaware utilized the shore-mounted windlasses, often turned by horses, and employed from fifty to sixty men each. Collectively they employed a thousand men and during the height of the spring runs would haul in 20,000 fish every twenty-four hours.¹⁰

The antebellum shad boom occurred at the same time that entrepreneurs using the Delaware for the transportation of raw materials and produce from the hinterlands were aggressively asserting their control of the river's waters. Plans to improve navigation had begun in earnest back in 1780 when private contributors had raised money to improve the passage of coal arks by clearing a channel through the rapids at Trenton. In 1783, a joint commission of New Jersey and Pennsylvania delegates had met to settle long-standing, unresolved disputes about the use of the river. The Commission's resolutions, passed by both state legislatures, declared the Delaware a common highway free and open for use by the residents of each state. The 1783 treaty also prohibited the construction of dams across the main stem of the Delaware unless both states repealed the treaty. (This agreement would remain in force until ratification of plans to construct the Tocks Island dam in the 1950s). The Delaware was soon ribbed by wing dams and diversions to control flow, but it remained an open river until the completion in 1828 of the sixteen-foot high Lackawaxon dam, near Milford, New Jersey, built by the Delaware and Hudson Canal Company to enable canal boats to cross the river. Although some shad were able to swim over it during springs with heavy rainfall and exceptionally high waters, during years of low precipitation the dam cut off the shad from 100 miles of upriver spawning grounds. The main stem of the

Delaware below the Lackawaxon remained free flowing, but partial barriers were abundant, silting or destroying prime spawning grounds in the lower river and forcing the shad to spawn in smaller creeks and streams.¹¹

Obstructions and diversions to improve navigation were not the only obstacles facing the shad. Untold numbers of shad fry and hatchlings were being caught in fish traps constructed to capture other species. These were most common along isolated, rough stretches of the river above Easton, where the narrow width and many falls allowed mountain families and small farmers, some of whose ancestors had lived in the region for generations, to funnel all fish migrating down-river into fish baskets and weirs. Unaware or indifferent to the impact of their actions on the fish population, many continued, as their ancestors had for generations, to use a variety of “iniquitous contrivances,” including makeshift dams, ell weirs, fish baskets and traps to collect whatever fish happened to pass through that section of the river. Elongated traps with large mouths set directly in the current called “fike nets” caused great kills on the upper river. These proved especially destructive to the fragile young shad fingerlings making their way back downstream to the ocean each fall.¹²

The numbers of shad in the upper Delaware plummeted after completion of the Lackawaxon dam. The Howell family fishery at Woodbury, New Jersey—one of only two to keep records before the 1880s—had averaged a catch of 130,000 fish a year before 1825. From completion of the dam until the 1870s the catch would fall to 25,000 a year or less. Fueled by rising prices, the annual catch along lower river continued to increase, reaching close to a million and a half pounds per year by 1837. But the huge harvests were placing tremendous strains on a fish population whose spawning grounds were drastically decreasing in size. As early as 1820, Delaware River fishermen were commenting on drastic decreases in the size of the fish they were catching, as once common eight-pound shad were already hard to find. The downward spiral typical of the overuse of the commons was in full force. As the supply of shad decreased, prices rose, drawing more fishermen to the river who could not afford to buy into shorefront properties.¹³

Fishing was broke out in the 1830s as ambitious “freebooters” attempted to get around the shore fisheries’ monopoly of the river. They challenged the system of riparian rights that had restricted entrance into the commercial fisheries by using a new method of fishing that freed them from all connection with the shore. In accordance with English common law regarding riparian rights, waters adjoining shorefront properties had since the earliest colonial settlements been vested in the hands of short-front property owners. Riparian rights along the Delaware were deemed so valuable that they often became separated from ownership of the land, remaining with the original property owners unless sold. Fancy Hill, for example, earned its owners a rental of

\$1,200 a year in the 1840s. But English common law doctrine also said that all waterways were publicly owned, their use and bounty to remain in the hands of all residents of the colony or state.

Working under the pretext that rivers were public property whose use could not be abridged, “freebooters” suspended a new style of gill net drifted between two boats, which dragged the river while floating downstream until their nets were loaded with fish. The larger mesh in gill nets allowed smaller fish to escape, enabling them to be handled by two men rather than large crews. The new gill nets not only provided a much more efficient means of capture than the old seine nets, but their use jeopardized shore front property values and many pocketbooks. Both the Pennsylvania and New Jersey legislatures had outlawed the use of drift nets in 1808, but the states failed to enforce this ban and overharvesting accelerated as shad landings plummeted.¹⁴

By the end of the Civil War the Delaware River shad fishery was on the verge of collapse. The old shore-fishery system had restricted access to the shad fishery, helping to limit the catches and preserve the fishery for close to one hundred years. Internal improvements, fish traps, and the utilization of more efficient nets wielded by the growing numbers of fishermen claiming the rights of free access to a public resource brought about collapse of the fishery in less than thirty years. The Delaware River shad fishery in the antebellum era followed the boom and bust pattern of fisheries the world over, its history exemplifying what historian Arthur McEvoy has called the “fisherman’s problem”; that is, where the incentives for fishermen to overfish are great and where there are no market mechanisms to reward individual forbearance in the use of shared resources, overfishing is inevitable. In 1872, fisheries above Milford yielded only a single fish. The following year all the Delaware River shad fisheries failed to meet their expenses. And the fish that were caught continued to diminish in size. It had taken only about forty shad to fill a pork barrel in 1843. By 1873 it took more than 100, and a four-pound fish had become a curiosity. Decreased yields, smaller fish, and higher prices all served to transform regional foodways. In early decades of the nineteenth century a single shad had furnished a substantial meal for a laborer and his family. By the 1860s shad had become a luxury beyond their means.¹⁵

Phase Three: The Shad Boom of the Industrial Era

The collapse of the Delaware River basin shad fishery was not an isolated event. By the 1860s the overfishing of America’s food fish had become a national crisis. With price the primary mechanism regulating their harvests, America’s commercial fisheries followed the “Invisible Hand of the Marketplace” and left trails of devastation in their wake. Overfishing had wiped out the American Coast salmon fishery in the 1850s. The American oyster industry, by far the nation’s largest and most profitable fishery, was in a state of

crisis. Once the Civil War was over, both the state and federal governments turned their attention to restoration of the nation's food fisheries. Alarmed by the depletion of shad in the Susquehanna and Delaware and of sport fish in its mountain streams and lakes, the Pennsylvania legislature appointed James Worrell its first state fish commissioner, his principal mandate being to restore the state shad fishery. To that effect he engineered passage of laws that required fish ways and sluices to allow passage for fish on all the state's major riverways (1866), and forbade the use of fish baskets, weirs and other traps (1871). In 1873 the Pennsylvania legislature set up a three-person fish commission to plan systematic restoration of the shad on the state's rivers.¹⁶

Congress began taking an active role in the economic development of the nation's fisheries in 1871 when it established the United States Fish Commission (USFC) and gave it a broad mandate to study the causes of the decline in coastal fisheries. The USFC constructed a laboratory for the study of fish biology at Woods Hole, Massachusetts, sponsored research on fisheries problems, and sent out investigators to gather information on the fisheries of other nations. Most of the USFC's biological research concentrated on the artificial propagation of fish from eggs and milt captured from wild fish. The state and federal governments both placed most of their hopes for revitalization of the nation's fisheries upon hatchery and restocking programs. Indeed, the hatcheries programs so overwhelmed USFC activities that they absorbed more than two-thirds of the Commission's annual budget, Congressional funding rising from \$15,000 to close to \$200,000 by the late 1880s. Testifying to the great importance that fisheries experts placed upon shad as one of the nation's major food fish, federal hatcheries programs committed most of their funding to the artificial propagation of the American shad.¹⁷

Once scorned as food for the poor, shad had won new-found appreciation for its resilience and its ability, like oysters, to be artificially propagated and "farmed" by humans. Johns Hopkins' University zoologist W. K. Brooks expressed scientists' enthusiastic embrace of shad as the ideal food fish, identifying it as "the most remarkable of domesticated animals, for it is the only one which man has yet learned to rear and to send out into the ocean in great flocks and herds to pasture upon its abundance, and to come back again, fat and nutritious, to the place from which it was sent out. From this point of view the maintenance of the shad fishery by man is one of the most notable triumphs of human intelligence over nature."¹⁸

Brooks' effusive articulation of the dominant nineteenth-century philosophy of technological and scientific solutions to environmental problems well expressed American biologists' and politicians' faith in human action. And at the time they seemed to work. Oyster growers were harvesting record numbers of oysters in the same waters through which the shad passed in their spring migrations. Parallels to the free-range American cattle industry, then

spreading like wildfire across the Great Plains, are also clear. Shad ranged free in the great plains of the oceans just as cattle grazed freely on the great inland ocean of the Plains. And shad required less supervision and management than cattle, rounding themselves up each spring as they massed for spawning in fishing grounds convenient to major population centers. Railroads, too, played a major role in the development of both industries, opening previously isolated regions to exploitation and carrying shad to inland markets just as they transported western cattle to eastern consumers.

Buoyed by their early successes in artificial propagation, and hoping that the shad's resilience would enable it to replace the diminishing salmon runs in California rivers, the USFC attempted to establish American shad in both the Pacific Ocean and Gulf of Mexico. A special train carried the first 10,000 shad fry to the Sacramento River in 1871. The release between 1876 and 1880 of more than a half million shad fry into California waters successfully established shad in Pacific coastal waters. Shad grew quickly in importance, proving especially popular among sportfishermen. Buoyed by their success in California, the USFC attempted to establish shad in other river systems, including the Mississippi. Artificial propagation and hatcheries efforts intensified after an 1880 study confirmed the rapid decline in the production and value of shad fisheries in Atlantic Coast rivers. Recognizing that the causes for the decline were outside of government control, the USFC determined to rescue eggs, impregnate and hatch fry, then return them to their native waters. In 1886 and 1887 the USFC loaded shad fry into the Connecticut and Delaware rivers, depositing sixteen million into the upper stretches of the Delaware and close to fifteen million in the vicinity of Gloucester. Successful experiments on raising shad in confinement began in 1885. Two years later close to a million shad fry were released into the Potomac.¹⁹

Federal stocking and hatcheries programs paled in comparison to those of state governments, nineteen of which had established hatchery programs by 1880. The Massachusetts and Connecticut fish commissions stocked more than 92 million shad into state rivers in 1872 alone. Pennsylvania began its own ambitious hatchery and restocking programs by placing 433,000 shad fry into the Delaware at New Hope in June, 1873. The Pennsylvania program would continue well into the twentieth century. Recreational fishermen also got into the act, purchasing and releasing thousands of salmon eggs and fingerlings to establish a salmon run on the Delaware.²⁰

Shad landings all along the Atlantic coast rebounded dramatically in the 1880s, and although most historians assert that stocking had little if anything to do with the rising yields, the expansion seemed to confirm Brooks' "triumph of human intelligence over nature." (The combined effort peaked in the late 1880s when state and federal agencies distributed 154 million shad eggs nationwide in a single year.) It is no wonder, then, that the planting of

millions of fish into streams and lakes throughout the United States was one of the most popular government programs of the day, viewed as a humanitarian attempt to provide American consumers a cheap and plentiful supply of healthful food.²¹

Recognizing that restocking would be ineffective if upriver impingements killed off too many migrating fish, the Pennsylvania Fish Commission in the mid-1880s hired game wardens to shut down the illegal fish traps and remove dams on the upper river. Traveling at times alone through the backwoods, some wardens combated armed and enraged fishermen. But the campaign proved such a success that the Commission in 1888 claimed that the Delaware River was free from lethal obstructions for the first time in the nineteenth century. Legislative initiatives also continued. To ensure the survival of other species in the river, the state outlawed the use of nets on the Delaware except for the catching of shad and made it illegal to fish on Sundays. Recognizing that protection of the region's fisheries required interstate cooperation, a commission of Pennsylvania, New Jersey, and Delaware delegates held several meetings in Philadelphia to formulate a code of laws uniform for the entire river. One outcome was the construction in 1890 of a fishway on the Lackawaxon dam.²²

What impact did the stocking programs and the enforcement of new laws and regulations have upon restoration of the American shad? At the time, efforts to restore shad runs appeared to be successful all along the Eastern seacoast. The number of shad caught between North Carolina and Connecticut rose steadily from 4.141 million fish in 1880 to 7.66 million fish in 1888. Shad harvests peaked nationwide in the late 1890s when the close to 50 million pounds netted made shad far and away the Atlantic Coast's most valuable finfishery. Although experts at the time attributed much of the increased yield to the efforts of the fish culture work by the USFC and its state counterparts, the reasons for the extraordinary increases lay elsewhere.²³

Population growth and industrialization drove the expansion of the American shad fishery. In the post-war era the shad industry expanded and modernized, transformed by technological innovations in fishing and transportation. Increased harvests stemmed from the capture of a higher percentage of the spring runs through the use of larger seine nets, some hauled in by means of steam engines, the introduction of larger, power-driven boats, and the substitution of more efficient gill and seine nets for the older pound nets. Completion of railroad spurs to both sides of the Delaware estuary and Bay in the 1870s triggered rapid exploitation of these previously isolated bodies of water and integrated them into a nationalizing economy. Almost overnight, boom towns with names like Caviar, Shellpile, and Bivalve sprang up on the Jersey shores of the Bay. Shad harvests increased steadily for twenty years, rising from a million pounds in 1880 to more than nine million in 1887, to

record harvests at the turn of the twentieth century when more than sixteen million pounds of fish were hauled out of the river each spring. The value of the shad landings also grew dramatically, from \$52,500 to a peak value of over \$600,000 in 1891, making shad fishing a valuable regional industry.²⁴

In the 1890s the Delaware River Basin shad fishery was the nation's largest, and its catch of 3 to 4 million shad was several times greater than any other fishery on the Atlantic coast. Delaware River shad were being marketed in Cincinnati, Chicago, Cleveland, and western cities. To encourage further growth of their fisheries, states bordering the Delaware lent their assistance in marketing the products of their manufacturers and producers. Indeed, William Meehan wrote the first comprehensive history of Pennsylvania's fisheries for the Pennsylvania Pavilion at the Columbian World Exposition of 1893.²⁵

Phase Four: Shad As Cultural Artifact

A new culinary appreciation of shad as a desirable comestible accompanied the post-war revival of the Delaware River shad fishery. For a series of interrelated reasons, shad during the Gilded Age became "good to think," and achieved a culinary cult status that lasted from the centennial celebrations of 1876 into the early 1900s. To understand this newfound popularity one needs to look at the compensatory cultural functions that the shad fishing industry and shad eating played in the lives of modernizing Americans.

Because shad appear in the river for only a month or two each spring, fishermen had little incentive to invest in large vessels or expensive equipment. As a result, shad fishermen were slow to mechanize and the industry remained labor, rather than capital intensive. For generations, watermen living in the small shore communities of Delaware and New Jersey had survived on the bounty of the estuary and bay, fishing, oystering, hunting, farming, and trapping in a seasonal cycle that dated back many generations. Watermen employed a variety of techniques to catch their shad. On the Jersey side, watermen used stake nets that they could pound into the shallow bottom, leave untended, and then empty every day or two. On the Delaware side of the river drift netting was more common. Watermen on both shores caught the fish in homemade, flat-bottomed shad skiffs that ranged from twelve to twenty feet in length.²⁶

Shad complete their spring migration in little over a month. During the peak of the run watermen fished night and day, mounting small lanterns in the bows of their boats to guide their work, and catching sleep while they unloaded their haul and mended nets. Market boats met the fishermen on the open water, running the fish quickly to market on a daily basis. On the Delaware side, the shad were dumped into holding pens along the banks of the river, then transferred to railroad cars, which sped the fish directly to market. Stake and drift netting were cheap and efficient, so efficient that the old shore

fisheries could not compete. A handful of these survived by attaching themselves to riverside restaurants or staging springtime outings, catering to tourists seeking communion with the natural world and drawn by the novelty of the shore fisheries' pre-industrial operations.²⁷

Located just across the river from the salt marches at the southern end of Philadelphia, Gloucester had for generations been the symbolic center of the Delaware River shad industry. The site of annual pilgrimages of South Jersey farmers since the eighteenth century, Gloucester during the early decades of the nineteenth century had supported three large shore fisheries, which supplied the Philadelphia market. These fisheries, in decline since the 1850s, had their existence prolonged when local restaurateurs attempted to attract customers by exploiting traditional Delaware Valley foodways and drawing upon the historical associations of the shore fisheries, whose methods of operation had remained substantially unchanged for generations.

Historically, Delaware Valley residents had prepared fresh shad in many ways, the most popular being to nail fish fillets to oak planks, then cook them over open fires. To preserve the fish for later use, shad consumers traditionally salted it in brine or simply dried it, both techniques producing a food that most Americans would today find inedible. To improve the taste, families developed special recipes for smoking and flavoring. One popular technique was to prepare the shad much like a ham, rubbing the fish with salt, saltpeter and molasses, before smoking and drying it. During the antebellum era, Americans also began to acquire a taste for the roe, which until then had been given away to pigs or the poor. The Philadelphia cuisine created by free black caterers in the 1830s remained popular until French cuisine replaced it in the late nineteenth century, but not before a shad revival brought the fish unprecedented popularity among gourmards in the 1870s, cementing its position as one of the region's most distinctive foods.²⁸

The planking of shad, roasted on oak boards set along side of open charcoal pits, may well have been first practiced by American Indians. Early settlers embraced the technique which remained a local, private practice until the Wills family began to serve planked shad to parties at Gloucester beginning in 1840s at "The Old Brick." Planked shad moved from there to Chester and Philadelphia hostelrys, which largely monopolized the planked shad trade until 1876, the year of Great Philadelphia Centennial Exposition, when William J. Thompson left the Buena Vista House, a Gloucester landmark, and built a spacious hotel to the south. A heated rivalry with John Plum, the new proprietor of the Buena Vista, led to an advertising war which brought planked shad to national prominence.

The craze for fresh planked shad continued to spread in the 1880s. To attract diners to his riverside restaurant and hotel, Thomson in 1886 leased the old Hugg family fishery and made it one of the largest shore fisheries in

the history of the river. Under Thompson the old shore fishery employed sixty men at the height of the shad season and boasted a mammoth seine, twenty fathoms deep and 570 fathoms long. The yearly catch of more than 15,000 shad, 180,000 herring, and assorted other fish was equally impressive. In 1886, Gloucester hotels served 10,000 diners. Thompson, henceforth known as the "Duke of Gloucester," was reported to have brought planked shad "to such a state of perfection" that his hotel became a resort not just for Philadelphians but visitors from throughout the nation and abroad.²⁹

The new culinary interest in shad did not stop at Gloucester. Well-to-do sportsmen organized shad net-fishing and eating clubs all along the length of the river. The spring shad run also became the focus of outings for less well-to-do urbanites. Local fishermen on the few remaining shore fisheries above Philadelphia set up cabins and picnic areas for trainloads of vacationers, some of whom came from as far away as Pittsburgh to eat planked shad, listen to the music, dance, relax, and take in the spring air along the banks of the river.³⁰

What, then, explains the faddish popularity of this extremely bony and oily fish? Eating shad on the banks of the Delaware became a cultural ritual, a culinary, equinoctial sacrament in which urban Anglo-Americans could reconnect with the natural world and with their rural, pre-industrial ancestors. Finding in the shad fishermen a relic of their own disappearing Anglo-American past, artists and writers romanticized the watermen who lived in the small towns that dotted the Delaware River and Bay and who came overwhelmingly from old Anglo-American stock. Articles about shad fishing on the Delaware that ran in *Harpers* and other popular magazines documented the tradition for armchair readers. Fishing clubs on the banks of the river became centers of male bonding for sportsmen drawn from the Philadelphia gentry, who concocted new recipes and wrote poems celebrating the rituals of boning and preparation of the shad for eating—and the drinking that must accompany such a "weighty affair."³¹

The most famous celebrant of the Delaware River shore fisheries was Philadelphia painter Thomas Eakins, who in the early 1880s made springtime pilgrimages to Gloucester to photograph and paint the shad fishermen at work and to eat planked shad with family and friends at Thompson's Hotel. Wealthy Philadelphians embraced shad and shad roe as their own. No longer a food for the poor, shad—like pepper pot, oyster stew, and red snapper soup—was now a distinctive regional tradition.³²

There may also have been a religious dimension to the shad craze of the late nineteenth century. Planked shad festivals might be viewed as secularized continuations of the spring love feasts of many Protestant denominations. The Moravians of Bethlehem, Pennsylvania, for example, staged spring love feasts for generations and were great eaters of shad, which they served with a bitter salad of watercress. The fish is, of course, closely associated with Christ.

As Christ was nailed to the Cross, so the shad were nailed to oak boards. Christ rose from the grave at Easter. Shad are the first fish of spring, arriving soon after the spring equinox. So eating shad was symbolically resonant on any number of historical, religious, and mythic levels. Here modernizing Americans could renew their bonds with Nature in an age-old equinoctial celebration, Christians participate in an Easter communion, and Anglo-American families commune with the simpler agrarian world of their ancestors. Central to all of these communions, of course, was the act of eating. Eaten informally in the open air or under open tents by the banks of the river, many participants must also have experienced the shad festivals as a pleasant reprieve from the strict etiquette of Victorian dining—an escape from the conventions of the modern world.

Confident of Nature's bounty and the abilities of science and human wisdom to ensure still higher yields, and spurred on by the penetration of new markets and the unprecedented popularity of shad among American consumers, fishermen flocked to the Delaware Bay. The great shad boom peaked at the turn of the century, then collapsed rapidly after 1900. Driven by rising prices and sustained by the employment of devastatingly efficient fishing technologies, the Delaware basin shad industry increased its harvests by moving downstream into the lower estuary and Bay. Uncommonly high precipitation may have also helped, enabling more fish to pass the Lackawaxon dam. The thirty-year shad boom that lasted between the 1880s and 1910, both nationally and in the Delaware, can best be understood, then, as a final cashing in on a once renewable resource. Fishermen all along the East Coast took so many fish out of the rivers that the shad were no longer able to sustain their numbers.³³

Phase Five: Decline and Fall

The shad renaissance unleashed by the Great Centennial Exposition lasted perhaps forty years. After a peak harvest of more than sixteen million pounds at the turn of the century, landings in the Delaware plunged to only three million pounds in 1905. A resurgence to seven million pounds in 1906 was then followed by another plunge. In 1916 fishermen took the last million pound haul out of the river. For the second time in less than fifty years the Delaware shad fishery collapsed. To reverse the declining yields, the Pennsylvania and New Jersey fish commissions stepped up their hatcheries and stocking programs. Even the City of Philadelphia got into the act, leasing a site at Torresdale where in 1904 it constructed a hatchery that specialized in shad. (It also hatched catfish, yellow perch, bluegill, and sunfish.) Stocking, however, failed to reverse the precipitous declines. The 11,540 million shad fry and 38 million perch the Torresdale hatchery placed into the river between 1904 and

1910 did, however, fuel an explosion in the number of eels in the river, which fed voraciously on the released fry.³⁴

The collapse of the Delaware River system shad fishery was part of a nationwide phenomenon. In the early 1900s shad landings in the United States plummeted to only about half what they had been in the 1890s. The harvests continued to shrink throughout the 1910s, bottoming out in the early 1920s at below fifteen million pounds. A brief resurgence in the late 1920s was followed by new record lows of less than eight million pounds in 1935, by which time shad had dropped to twenty-first in volume of Atlantic coast fisheries and eleventh in value. By 1950 the American shad fishery ranked thirty-eighth in volume and twenty-sixth in value.

The most severe declines took place in the Delaware, where the harvest dropped from a high of 16.5 million pounds in 1899 to four million pounds in 1908 to only 210,000 in 1921. In the 1920s Gloucester's remaining gill-netters complained angrily about the weak flesh and oily taste of the few fish they did catch. Drawn after 1920 by the lure of the easy money to be made by running rum, they stopped fishing. The last holdout was the venerable Captain John Chessam, an old-timer the Philadelphia press often interviewed for their annual spring shad features. Fishing the full three-month run in the spring of 1927, Chessam caught only fifty fish. That June he hung up his nets for the last time. The Gloucester shad fishery, in continuous operation for close to 200 years, existed no more. The collapse had been sudden. In 1912 the Pennsylvania Fish Protective Association could still declare the Delaware River "without a doubt, the best shad producing river along the Atlantic coast, if not in the country." Fifteen years later the Uniform Fishing Laws Concerns of the Delaware Bay and River declared the shad industry "no longer profitable."³⁵

Efforts to restore the shad runs, however, did not end. Despite clear evidence that stocking was ineffective, the New Jersey Fish and Game Commission in 1927 yielded to the pleas of veteran fishermen and built a small experimental hatchery at Pennsville, which moved up to Hancock Bridge the next year. The New Jersey stocking program peaked in 1938 when the Hancock facility released 6.2 million shad fry into the river. But the stocking programs at Torresdale and Hancock failed to restore the shad runs. To many older Pennsylvanians the shad's demise provided further evidence that industrialization and urban growth were out of control, destroying that essential balance between Nature and Civilization upon which the nation had been founded and upon which the future of the Republic still depended. Gone from the river, the shad now fully entered the world of ideas.³⁶

Why did the shad all but disappear from the Delaware River system? Although a scientific answer to this puzzle would not appear for decades to come, fisheries biologists, watermen, and the general public understood that

water pollution played a major role in the shad's disappearance. Water pollution had plagued Philadelphians for generations. Concerned about water quality and supply, Philadelphia had constructed the nation's first municipal water system in 1801. When consumption soon outstripped demand, the city in 1819 built a dam across the Schuylkill River and constructed a new steam-powered waterworks to pump river water into a reservoir atop the Fairmount Plateau.³⁷

In the nineteenth and early twentieth centuries Philadelphia exploded in size, soaring from 68,000 people in 1800 to more than 1,684,000 by the eve of the First World War. Philadelphians and their Delaware Valley neighbors put the Delaware and its tributaries to many, often contradictory uses, including deep water navigation, water supply, waste disposal, fisheries, and recreation. By the 1850s, water pollution caused by the dumping of human, industrial, and animal wastes was so endangering the city's municipal supply drawn from the Schuylkill River that the city began to purchase land for what would soon become the nation's largest urban park, a park created in large part to protect water supply.³⁸

Philadelphia's water use soared from 58 million gallons a day in 1880 to 319 million a day in 1910. Confident in the ability of its rivers to absorb and carry off waste, Philadelphia, by far the largest water user and abuser, continued to use the Schuylkill and Delaware as aqueous garbage cans. But as population and industry continued to grow the city found itself confronted by a water crisis of monumental proportions. Pollution of the city's unfiltered water supply subjected Philadelphians to periodic outbreaks of waterborne diseases, including major outbreaks of cholera in 1891 and 1899. Confronted by a major public health crisis, the city was forced to completely restructure its water supply and sewerage systems. Completion of the Torresdale sand filtration plant in 1908 and chlorination of all city water by 1912 ended cholera and typhoid's reign as a menace to public health. It failed, however, to solve the problem of a polluted water supply. Tests in the Delaware showed that water at the Torresdale intakes was dangerously contaminated by raw sewage carried upriver twice each day by the rising tides. A comprehensive waste disposal plan approved in 1915 required the city to construct three sewage treatment plants. But two world wars and the Great Depression would postpone water pollution abatement plans for decades to come. Philadelphia would not open the last of the three plants for the removal of colloidal solids until the 1950s. The city would not have the capacity to handle all waste flowing into the city's sewers until 1991.³⁹

For most of the twentieth century the stretch of the lower Schuylkill River and Delaware River between Philadelphia and Chester remained an open sewer, filled with industrial and human wastes. Effluents from the oil refineries and ship bilges coated the shores of the river with a black film and caused

huge fish kills. In the early 1900s, Philadelphia's sewers dumped more than 200,000 tons of solids each year, which combined with other solid wastes into deposits twelve feet deep. Exposed at low tides and churned up by incoming ships along the city's Delaware River wharves, they released an unbearable stench composed of sulfuric dioxide and other gases that assailed the nostrils of commuters using the Camden/Philadelphia ferries and drove sea-hardened sailors to jump ship rather than spend the night sleeping in their berths. In 1927, clean-water advocate John Fred Lewis could write that "Sewage in the lower Schuylkill has utterly destroyed its fishing and made its otherwise available banks unfit for human habitation and undesirable even for industrial purposes."⁴⁰

Clean water campaigns in the early 1920s and late 1930s had some local, state, and federal support. But strong industrial lobbies, lack of funding, and the complexities of enforcement prevented significant clean up. The main stem of the Delaware River was bordered by 838 distinct governmental units, thousands of factories, and tens of thousands of farms, making clear the need for an effective cooperative interstate. In 1936 New Jersey, Pennsylvania, and New York set up the Interstate Commission on the Delaware River (INCodel). INCodel immediately embarked upon a pathbreaking series of studies, filed lawsuits, and pressured all four states bordering the Delaware to pass pollution control legislation. To break regional opposition to river cleanup INCodel brought the Army Corps of Engineers to the Delaware to conduct scientific water pollution studies and to work with area industries on a new voluntary plan to reduce oil and refuse dumping.⁴¹

Pressured by INCodel and the engineers, river conditions improved, but effluents from industrial production in the Second World War quickly reversed the modest improvements of the previous two decades. During the war the Delaware received more waste than at any other time in its history, but the federal government refused to act because of its unwillingness to jeopardize maximum production for the war effort. The Port of Philadelphia became so vile that a number of ships simply refused to dock at their appointed destination. Tests indicated that the raw water entering Philadelphia's water treatment plants was the most polluted of any of the nation's major cities. In 1944, INCodel executive secretary James Allen fumed that Philadelphia was the foulest fresh water port in the world. That same year Louella Cable of the United States Fish and Wildlife Commission established that the huge volume of organic wastes dumped into the Delaware in the Camden/Philadelphia corridor was consuming the river's dissolved oxygen and creating a stretch of dead river in which few organisms could live.⁴²

The lower Delaware had become a dead stretch of open sewer extending during warmer weather anywhere from twenty to thirty miles in length. This pollution block caught the shad both coming and going, for not only did the

Philadelphia sag block the shad from swimming to their spawning grounds in the upper river each spring, but the juvenile shad, which were born upriver, ran into the block when they headed out to the Atlantic Ocean each fall, suffocating by the tens of thousands. By the late 1940s, the shad had all but disappeared from the river above Wilmington, Delaware. Cut off from their prime spawning grounds, shad entering the Bay also decreased in number. A record-low catch of 38,000 pounds in 1949 led to the passage of protective legislation designed to preserve the Delaware Basin shad fishery from total extinction.⁴³

Phase Six: The Return of the Shad

After the federal government in 1944 officially declared the Delaware a "black water" river, the century-old trend of deteriorating water quality finally began to reverse. Pressured by INCODEL, Pennsylvania Senators Joseph Guffy and James Davis persuaded the federal government to reverse its position that river clean-up was only a state problem. Confronted by mounting public support for clean water, Governor Edward Martin ended his opposition and came out firmly for pollution control, committing the state to INCODEL's joint state and federal plan to solve the coal siltculm problems on the Schuylkill. Inadequate funds had always been a major roadblock to pollution abatement. Pennsylvania's 1937 pollution control law had attempted to solve this chronic problem by approving the collection of annual rental fees to fund work on Philadelphia's sewage system and treatment works. In 1944 the state Supreme Court finally approved the Philadelphia ordinance for self-sustaining sewer rents, to go into effect on January 1, 1946. Passage of the 1948 Federal Water Pollution Control Act, which placed the pollution of interstate waters under federal jurisdiction and made available federal funds for river clean-up, was the last missing piece to the puzzle. With funding mechanisms now in place Philadelphia adopted an ambitious new \$80 million plan to construct three primary sewage treatment plants to be completed by 1953. For the first time work proceeded almost on schedule, the last of the three plants opening in December, 1955.⁴⁴

Unfortunately, Philadelphia's new wastewater treatment plants had little impact upon the river. Two of them only provided primary treatment, which removed suspended solids. This helped reduce the volume of sludge dumped into the river but did little to improve the levels of dissolved oxygen. Water-born bacteria continued to use all the available dissolved oxygen in their digestion of the colloidal solids poured untreated into the river. In addition, major sewer lines still remained unconnected to the plants, all three of which lacked the capacity to handle the heavy flows unleashed by rainstorms, during which storm runoff mixed with raw sewage and flooded directly into the river. Post-war residential and economic development above Philadelphia also cre-

ated a whole new set of problems. Growth in the Lehigh Valley corridor between Allentown and Phillipsburg, for example, turned the Delaware's Lehigh River tributary into an open sewer. Spurred by the construction of two Levittowns and a new U.S. Steel Plant at Fairless Hills, suburban population along the main stem of the Delaware above Philadelphia more than doubled between 1950 and 1968. By the latter date more than a billion gallons of liquid waste a day poured into the river.⁴⁵

Although the post-war pollution control efforts did not clean up the lower Delaware, they did succeed in decreasing the length and duration of the Philadelphia sag. Mother Nature did her part too. Twin hurricanes in 1955 caused perhaps the worst flooding in the history of the river, but also scoured out pollution-saturated sediments that had been accumulating for decades and washed them out to the sea. And with this purging the shad returned to the Delaware, reappearing in the upper river sometime around 1960. Just as the fish were reappearing in the river, however, a severe drought not only placed the future of the new shad runs in jeopardy but also led to passage of legislation to construct a dam across the Delaware River at Tock's Island, just below the Walpack Bend.⁴⁶

The dam aroused fervent opposition, especially among the growing numbers of recreational anglers who had discovered in the resurgent shad runs the region's best sport fish, for it would have blocked the shad from their most important nurseries. Since its disappearance in the 1920s the importance of shad restoration had been predicated upon the monetary value of the commercial fishery. The return of the shad to the Delaware River failed, however, to restore the once valuable commercial fishery, for most residents of the Delaware Valley no longer found shad "good to eat." (Shad is a very boney and comparatively oily fish). The shad did, however, become very, very "good to think" among growing numbers of recreational anglers who fought for the fish's right to the river system with tenacious commitment and enthusiasm.⁴⁷

Shad fishermen and state and federal fisheries biologists worked hard for restoration of the shad. In so doing they confronted two major hurdles. The short-term problem was a drought that was slowing the shad's resurgence. Low rainfall in 1961, 1963, and 1965 left the Philadelphia pollution block intact, barring the shad from their upriver migration and producing major fish kills. "The future outlook for the shad in the Delaware presents a rather gloomy picture," warned Dr. Jay L. Harmic of the Delaware Fish and Game Commission in 1963. But bad weather in 1962 and 1964 increased river flow and allowed the fish to pass through the Philadelphia pollution block into the upper river.⁴⁸

The Tock's Island Dam represented a second and more significant threat to the shad, a threat quickly grasped by both recreational anglers and the cadre of fisheries biologists working on the river. Construction of the dam would

have eliminated the only viable spawning grounds just as the shad were re-establishing themselves in the river. Historically, the shad's primary spawning grounds had been in the tidal portions of the lower river. But pollution, dredging, and other human impacts on the estuary had long since wiped these out. The seasonal nature of the Philadelphia pollution block meant that the shad's survival was now dependent on fish who spawned in the upper reaches of the river above the Delaware Water Gap. Since shad fry born in the upper reaches required the longest fall migration, they arrived at the pollution block latest in the season—after temperatures had dropped enough for the dissolved oxygen to rise high enough to permit passage of fish back to the ocean. Tocks Island would have cut off the shad from these spawning grounds and thus eliminated the shad's primary remaining spawning grounds in the Delaware system. Fishways were one potential solution but shad had proved reluctant to use them on other river systems.

By the late 1960s, recreational anglers and the Pennsylvania Fish Commission were active in the growing anti-Tock's coalition. The fisheries' biologists greatly strengthened the arguments against the dam, by pointing out and providing evidence on the potential problems of eutrophication and pollution buildup in the reservoir and resulting loss of fish and wildlife. Indirect assistance also came from the growing national environmental awareness and new federal initiatives, including creation of the Delaware Water Gap National Recreation Area in 1965, and passage of the Wild and Scenic River's Act in 1968 and the National Environmental Policy Act of 1969. The organization in 1971 of the Save the Delaware Coalition, a loose confederation of sportsmen's, environmental, and other organizations whose national members now included the Sierra Club, the Wilderness Society, and the National Wildlife Federation gave added strength to the forces opposing the dam. By the mid-1970s, a combination of environmental and sportsmen's opposition, the ending of the drought, and the inflationary effects of the Vietnam war had forced cancellation of the dam.⁴⁹

The struggle against the Tocks Island Dam had also mobilized the organization of sportsmen's clubs and citizen's action groups dedicated to the protection of a free flowing river. In the following years they emerged as powerful clean water lobbies that local politicians could ignore only at their own peril. State and federal fish and wildlife officials spoke with new authority and shad fishermen teamed together with environmentalists to form a powerful lobby for the protection of the Delaware and its tributaries. Emerging as major players in the shaping of regional water use policies, clean river advocates could no longer be ignored by the traditional power brokers of industry, navigation, and water supply.

Recognizing the commercial potential of the new recreational shad fishery—and pressured by politically active sportsmen's organizations—states

bordering the Delaware committed money to the protection and expansion of the shad fishery while states bordering the estuary made plans to restore the shad to Delaware. To attract out-of-state anglers the state of Delaware in the mid-1960s decided to restore shad to the Brandywine River by constructing fishways on the river's eleven dams. Convened to determine whether shad could be restored to the Susquehanna, the United States Bureau of Sport Fisheries and Wildlife, the Pennsylvania Fish Commission, the Maryland Board of Natural Resources, the Bureau of Fisheries, and the New York Conservation Department issued a joint study that led in 1972 to the construction of an elaborate fish ladder on the Philadelphia Electric Company's Conowingo Dam. The Delaware River Shad Fishermen's Association, organized in 1976, campaigned to get shad restored to the Lehigh River. In 1989 it won a \$3.3 million state appropriation for fishways on the Easton and Glendon dams. Opening of the fishways in the spring of 1995 enabled the shad to return to a river system from which they had been excluded for over 150 years.⁵⁰

Today the future looks bright for the shad, as state and federal anti-pollution legislation has greatly improved water quality in the Delaware. More than 70,000 anglers come to the Delaware each spring, pouring well over \$3 million into the local economy. In recent years shad festivals along the Delaware have become annual, well-attended events, reviving the excursions of the late nineteenth century. Growing numbers of recreational fishermen, environmentalists, and other residents of the Delaware River Basin are finding shad "good to think" for reasons other than their value as a good fish. (Many avid shad fishermen now throw their fish back rather than eat them). That bodes well for both the fish and the Delaware River system, for if Americans did find shad good to eat, recreational anglers and commercial fishermen would probably fish them out in less than a decade.⁵¹

Despite the recent recovery and ambitious plans for restoring fisheries to other river systems, water quality in the Delaware and its tributaries is still in constant danger. It is ironic that now that the shad have returned, their utility as an indicator of environmental integrity may be misleading. The large volume of shad may direct attention away from the more serious problems of loss of species diversity and degradation of the riverine ecosystems at a very fundamental level. Agricultural runoff, residential development along the river's banks, oil spills, and illegal dumping of toxic wastes still jeopardise river health. It may well be that the old human waste and industrial dumping problems of the past will prove easy to remediate when compared to the current threats to water quality. As sewage treatment has improved, new pollution problems, including the illegal dumping of toxic chemicals, have emerged to take their place. An extremely dense concentration of more than 120 chemical manufacturing plants and the largest massing of petrochemical facilities in the nation hug the Delaware's shores, producing plasticizers, industrial solvents, and

specific aromatic hydrocarbons; chemicals about whose potential toxicity we still know little. The Delaware River suffers from extremely high levels of mercury, zinc and cadmium concentrations, ranks in the nation's top ten rivers in levels of organochlorine insecticides, and contains perhaps the third highest concentration of PCBs of any major river in the nation.⁵²

Water supply also promises to re-emerge as a critical issue as suburbanization increases demand. Although the population of the Delaware River Basin stabilized in 1980 at about seven million people, water usage increased from five billion gallons a day in 1979 to seven billion in 1987. Major problems from residential development have emerged, for example, in south Jersey, where people draw their water from the once vast Potomac-Raritan-Magothy Aquifer, which runs from Long Island to North Carolina. At the turn of the century the aquifer was so high that it poured water into the Delaware River. By 1991 it was more than 80 feet below sea level and dropping an additional two feet every year. The aquifer now draws water from the Delaware River and Bay, much of that saline or contaminated. River flow now has to be augmented during dry seasons to prevent salt from contaminating wells in South Jersey.⁵³

Increased water usage has also been accompanied by an increase in the volume of sewage. Sewage production in the five county area increased ten percent between 1988 and 1993, to roughly 775 million gallons a day. Although sewer plants have improved their treatment, smaller streams and rivers flowing into the Delaware are less capable of carrying the growing volume of wastes, for suburban development has cut off their ground-water sources and converted major secondary rivers and streams into mere arteries for storm-water drainage. The volume of treated wastes being dumped into smaller streams such as the Wissahickon, Brandywine, and Neshaminy is so great that the streams are incapable of purifying themselves. The Wissahickon, hailed for centuries as one of Philadelphia's most beautiful natural wonders, has become, to paraphrase one local reporter, as putrid as it is picturesque. In the early 1990s the Wissahickon each day received ten million gallons of treated sewage from four major municipal plants and several smaller ones, about one-sixth its average flow. As much as 90 percent of the Wissahickon's summer flow is now treated waste water. A 1992 report by the Pennsylvania Department of Environmental Resources estimated that 43 percent of the streams the DER assessed in the Philadelphia region remain polluted.⁵⁴

Notes

I thank Roger Allen and Joe Miller for their assistance in teaching me about the history of the shad in the Delaware River Basin, and Michael Black and Joel Tarr for their help in the preparation of this article.

1. For excellent introductions to the Delaware River Basin and the history of the river see The Delaware Estuary Program, *Comprehensive Conservation and Management Plan for the Delaware Estuary*, Public Review Draft, 1994, and Bruce Stutz, *Natural Lives, Modern Times: People and Places of the Delaware River* (New York: Crown, 1992). For an overview of the Delaware River basin shad fishery see J. P. Miller, F. R. Griffiths, and P. A. Thurston-Rogers, *The American Shad in the Delaware River Basin* (mimeographed report, Delaware Basin Fish and Wildlife Management Cooperative, 1982).

2. Albert C. Meyers, *Early Pennsylvania, West New Jersey and Delaware, 1630-1707* (New York: Barnes & Noble, 1940; orig. pub. 1912), 25, 266; John F. Watson, *Annals of Philadelphia*, vol. 1 (Philadelphia: Elijah Thomas, 1857), 17-18, 46; John Gay, "The Shad Streams of Pennsylvania," *Report of the Pennsylvania Commission of Fisheries for 1889-1890-1891* (Harrisburg: 1892), 151-187.

3. The Lenape called the month of March, Chwame Gischuch, which translates as the month of the shad, and held an annual fish festival that lasted five to six weeks. On Native American shad fishery see A. R. Dunlap and C. A. Weslager, "Contributions to the Ethno-History of the Delaware Indians in the Brandywine," *Pennsylvania Archeologist* 30:1 (1960), 18-21, *Philadelphia Bulletin*, April 30, 1942, and "Early Indian Methods of Cooking Fish," *Report of the State Commissioners of Fisheries, for the Years 1892-94* (Harrisburg: 1895). The earliest colonial records of shad runs are to be found in Moravian diaries from mid-eighteenth century. See George Henry, *The History of the Mission of the United Brethren Among the Indians of North America* (1794), and Nelson, V. H. "Shad in early Bethlehem." *Berks County Historical Society Archives* (1980). John W. Jackson, *With the British Army in Philadelphia 1777-1778* (San Rafael, CA: Presidio Press, 1979).

4. Evidence of the significance of shad in colonial diets can be found in Gay, 156, 166; William E. Meehan, *Fish, Fishing and Fisheries of Pennsylvania* (Harrisburg: E. K. Meyers,

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5. Charles Hagner, *Early History of the Falls of Schuylkill* (Philadelphia: Claxton, Remsen and Haffelfinger, 1869); Meehan, 25.

6. Mary Hanna, "Trade of the Delaware District Before the Revolution," *Smith College Studies in History* vol. 2:4 (July 1917), 256-262. For a superb introduction to the history of the American cod fishery see Mark Kurlansky, *Cod: A Biography of the Fish that Changed the World* (New York: Penguin Books, 1997). On New Englanders' contempt for shad see Meehan, *Fish, Fishing and Fisheries of Pennsylvania*, 20, and *Philadelphia Bulletin*, April 7, 1939.

7. Watson, *Annals of Philadelphia*, vol. 2, (Philadelphia: Elijah Thomas, 1857), 160. For an account of the Longford fishing war see Samuel H. Pennypacker, *Annals of Phoenixville & Its Vicinity* (Philadelphia: Bovis & Pennypacker, 1872), 28-37; and Meehan, 25-31.

8. Edward S. Gibbons, "The Building of the Schuylkill Navigation System, 1815-1828," *Pennsylvania History*, vol. 57:1 (January 1990), 13-43; Meehan, 33.

9. Gay, 179-181; Meehan, 22-25.

10. Watson, 631-32; J. W. Collins, "The Shore Fisheries of Southern Delaware," *History and Methods of Fisheries*, vol. 1: Part VII (Washington D.C.: Government Printing Office, 1887), 656.

11. The damming of the main stem of the Susquehanna River at Nanticoke in 1830 would have an even more devastating impact, killing an important upriver shad fishery that still provided a primary source of food and income for literally tens of thousands of Pennsylvanians who lived above the dam. See Meehan, 33; H. B. Weiss and G. M. Weiss, *Rafting on the Delaware River* (Trenton: New Jersey Agriculture Society, 1967).

12. Meehan, 36; Pennsylvania Fish Commission, *Report of the State Commissioners of Fisheries for the Years, 1892-94* (Harrisburg, 1895).

13. Gay, 183-184; Dr. Samuel Howell, "Notes of the Shad and Shad Fisheries of the Delaware," *American Journal of Sciences and Arts*, 32 (1837).

14. Collins, 656; *Harpers Weekly*, April 30, 1881; *Philadelphia Bulletin*, May 2, 1949.
15. On the life cycle of American fisheries see Arthur F. McEvoy, *The Fisherman's Problem: Ecology and Law in the California Fisheries, 1850-1980* (New York: Cambridge University Press, 1896), 1-12. On declines in the Delaware see Meehan, 35; Gay, 183-84; Watson, 631-632, and Thaddeus Norris, "A Plea for Shad," *Lippincott's Magazine* (April 1869), 448. The collapse of world fisheries due to the same lack of incentives for conservation is documented in Peter Weber's "Net Loss: Fish, Jobs, and the Marine Environment," *Worldwatch Paper #120* (July 1994).
16. Gay, 171; Dean Conrad Allard Jr., "Spencer Fullerton Baird and the U. S. Fish Commission" (Ph.D. dissertation, George Washington University, 1967), 116-117; Lewis E. Beitler, *Game and Fish Laws and Warden and Forestry Law of the Commonwealth of Pennsylvania, 1889* (Harrisburg: Wm. Stanley Ray, 1899), 34-60.
17. Allard, 121-134.
18. R. Mansueti, *A Historical Review of the Shad Fisheries of North America* (Chesapeake Biological Laboratory, Solomon, MD, Pub# 97, 1953), 85.
19. Allard, 262, 265; United States Fish Commission of Fish and Fisheries, Part 15, *Report of Commissioners for 1887* (Washington D.C.: Government Printing Office, 1891) xxxv-xliv.
20. Gay, 177-179, 185-186; William Meehan, "The Shad Work on the Delaware River in 1907 and Its lessons," *Transactions of the American Fish Society* (36), 106-110. *Philadelphia Bulletin*, June 21, 1953. In 1990 the New Jersey Division of Fish and Game touted a plan to introduce Pacific salmon to the Delaware. This time the idea met stiff resistance from recreational fishermen who feared the impact on the flourishing trout populations. See *Philadelphia Inquirer*, September 3, 1990.
21. Marshall McDonald, "The Fisheries of the Delaware River," *Report of Commissioners for 1887*, vol. 1 (Washington D.C.: Printing Office, 1887), xlv. For a provocative analysis of the failure of technological solutions to fisheries problems see Michael Black, "Tragic Remedies: A Century of Failed Fishery Policy on California's Sacramento River," *Pacific Historical Review* (1995), 37-70.
22. Meehan, *Fish, Fishing and Fisheries of Pennsylvania*, 48-49.
23. McDonald, xlix; Mansueti, 1.
24. Mansueti, 23-77. The Delaware Bay is 600 square miles of comparatively deep and open water which make it much rougher and less hospitable than the Chesapeake. The major currents of the Delaware Bay swing north along the New Jersey shore of the Bay and estuary, carrying fish with them. For an excellent introduction of the ecology of the Delaware River Basin see Jonathan H. Sharp, "Dynamics," in Tracy L. Bryant and Jonathan R. Pennock (eds.), *The Delaware Estuary: Rediscovering a Forgotten Resource* (Newark: University of Delaware Sea Grant College Program, 1988).
25. Mansueti, 108. Of the 3.9 million fish hauled from the Delaware in 1896, fishermen took 11.1 million from the Bay, 2.6 million from tidewater, and only 176,000 from the upper river. Eighty percent of the shad taken in tidewater were captured in drift nets. Most of the Delaware River basin fishery was controlled by Pennsylvanians, who owned the railroads and market boats, while local watermen who lived in the shore communities conducted the actual fishing. See Meehan, *Fish, Fishing and Fisheries of Pennsylvania*, 50.
26. On the history of the Delaware Bay finfisheries in the late nineteenth century, see C. C. Abbott, "Notes on some Fishes of the Delaware River." U.S. Commission of Fish and Fisheries, *Report of the Commissioner for 1875-76*. vol. 4 (Washington D.C.: Government Printing Office, 1877), 825-845; Collins, 533-654; Gay, 151-187; Goode, 533-538; and McDonald, 654-57.
27. C. H. Stevenson, "The Shad Fisheries of the Atlantic Coast of the United States." *Report of the U.S. Commission of Fish and Fisheries for 1914* (Washington D.C.: U.S. Gov. Printing Office, 1915), 23; J. Sykes, "Past and Present Delaware River Shad Fishery," U.S. Fish and Wildlife Service, *Report #46*. 1957. New Castle and Delaware City acted as major markets for sale of shad, some 14 million pounds caught by Delaware fishermen each year. Delaware City stored shad in "live cars," fish boxes, shipped to Philadelphia in water filled tanks. James G. Horner, "The History of the Commercial Fishing Industry in Delaware (unpub. mss, University of Delaware, 1957), 9-13. Interviews with Bob Beck, October 5, 1988, and Fred Lewis, November 18, 1988.
28. On Philadelphia culinary traditions and shad see Mary Anne Hines, Gordon Marshall,

- and William Woys Weaver, *The Larder Invaded: Reflections on Three Centuries of Philadelphia Food and Drink* (Philadelphia: The Library Company of Philadelphia and The Historical Society of Pennsylvania, 1987); Philip C. F. Smith, *Philadelphia on the River* (Philadelphia: Philadelphia Maritime Museum, 1986), 105-107; and William W. Weaver, "When Shad Come In: Shad Cooking in Old Philadelphia" *Petits Propos Culinaries II*, (1982), 7.
29. *Philadelphia Bulletin*, March 10, 1927; May 25, 1938.
30. Interview with Fred Lewis, November 18, 1988.
31. Susan A. Popkin and Roger Allen, *Gone Fishing! A History of Fishing in River, Bay and Sea* (Philadelphia: Philadelphia Maritime Museum, 1987), 12-18; *Harpers Weekly*, April 30, 1881; April 19, 1890; *The Illustrated London News*, October 20, 1883. A wonderful poem on the delights of shad preparation and consumption can be found in Schuylkill Fishing Co. *A History of the Schuylkill Fishing Company, 1888-1932*. vol. 2, (Philadelphia: Schuylkill Fishing Co., 1932), 470.
32. Eakins took close to fifty photographs documenting the industry and completed in 1881 and 1882 a series of watercolors, drawings, and paintings, including "Shad Fishing at Gloucester on the Delaware River," (1991), Philadelphia Museum of Art. See George Hendricks, *The Life and Works of Thomas Eakins* (New York: Grossman Pub., 1974).
33. William Meehan, "The Shad Work on the Delaware River in 1907 and Its Lessons," 111. During these decades the Delaware Bay was experiencing catastrophic losses of oysters and sturgeon as well. Being the region's most valuable fishery, the Delaware Bay oyster industry was extremely well documented. For a brief overview see Bryant and Pennock, *The Delaware Estuary: Rediscovering a Forgotten Resource*. For an introduction to the sturgeon fishery see United States Commissioner of Fish and Fisheries (Washington D.C.: Government Printing Office, 1900), 369-380; H. J. Smith, "Sturgeon Fishing of the Delaware River," Bureau of Fisheries, Report of the U.S. Commission of Fisheries for 1914 (Washington D.C.: Government Printing Office, 1915).
34. *Philadelphia Bulletin*, August 23, 1915; January 18, 1956.
35. Miller, Griffiths, and Thurston-Rogers, *The American Shad in the Delaware River Basin*, Table 3, p. 108, provides figures for shad landings from 1880 through 1979. The Pennsylvania Fish Protective Association, *Twelfth Annual Report* (Philadelphia: 1912), 8; *Philadelphia Bulletin*, April 14, 1924, June 20, 1927. Also see C. N. Birch, "Pollution and the Shad Industry," *Annual Report of the New Jersey Board of Fish and Game Commission*, (Trenton: 1931).
36. *Philadelphia Bulletin*, May 27, 1928; April 15, 25, 1938; and January 18, 1956.
37. For an introduction to the history of Philadelphia water supply in the nineteenth century see Sam Bass Warner, *The Private City: Philadelphia in Three Periods of Growth* (Philadelphia: University of Pennsylvania Press, 1968), 102-111; Michael McMahon, "Make-shift Technology: Water and Politics in 19th-Century Philadelphia," *Environmental History Review* 12 (Winter 1988), 22-37; and James W. Follin and E. Lewis Burnham, "The Water Supply Problem of Philadelphia" (Philadelphia: Bureau of Municipal Research, 1922), 46-49.
38. Even human health concerns could be used to legitimate industrial dumping. In 1916 State Commissioner of Health Dr. Samuel G. Dixon saw nothing wrong with acidic industrial runoff in the state's streams, noting that acids were a powerful germicide that protected public health. "The people seem more concerned about the killing of fish than they do about a real health menace." Dixon complained, insisting that the real menace was typhoid, not acid runoff. See *Philadelphia Bulletin*, December 23, 1916.
39. Follin and Burnham, 11; City of Philadelphia, *Report on Water Supply*, (1899), 11-12. During droughts and in the aftermath of storms, Schuylkill River water contained so much suspended matter that local papers joked about people emerging from their tubs blacker than they had entered them. See *Philadelphia Inquirer*, October 8, 1906, and *Philadelphia Evening Bulletin*, August 22, 27, 1906. Typhoid rates declined from 60 per 100,000 in the four year period between 1902 and 1906 to only 7.5 per 100,000 in 1914. See City of Philadelphia, *Department of Public Works, Report on the Collection and Treatment of the Sewage of the City of Philadelphia, 1914* (Philadelphia: 1914), 26. For brief overviews of the recent history of Philadelphia's waste water treatment system see William J. Marrazzo and Susan Panzitta, "Progress on the Delaware River

Cleanup Program," *Options for Reaching Water Quality Goals* (American Water Resources Association, August 1984), 13-21; Robert F. Walker, "The Philadelphia Water Department—A Regional Utility," *Journal of Water Pollution Control* (September 1987), 804-809. 40. For an angry and impassioned expose of the pollution of the Schuylkill see Frederick L. Lewis, *The Redemption of the Schuylkill* (Philadelphia: City Parks Association, 1924). During large spills fish died in such numbers that on occasion the stench drove shore-side residents from their homes. See *Evening Bulletin*, June 26, 1929.

41. Water Supply and Sanitation Committee, "Semi-Final Draft of Report on Water Supply and Sanitation Problem in the Philadelphia Tri-State District," (August 1931), 42, 75; *Philadelphia Bulletin*, April 3, July 30, 1936.

42. *Philadelphia Bulletin*, December 10, 1937; August 25, 31, 1938; July 17, 23; August 20, 1943. Earl and Dorothy Selby, "Clean-up on the Delaware," *Colliers* (January 5, 1946), 52, 53, 64; Krappen Tibbetts, "Delaware River Port Development Plan" (Delaware River Joint Commission of Pennsylvania and New Jersey, November 1948), 58. Shad need a minimum of 5 part per million of oxygen in water to survive. By the 1910s the springtime levels of available oxygen in the Philadelphia/Camden corridor had dropped to between 2 and 0 parts per million. On the Philadelphia oxygen sag see P. R. Kiry, "A Historical Look at Water Quality of the Delaware River Estuary to 1973," *Annals of the Academy of Natural Sciences of Philadelphia* (1974).

43. The last of the old upriver shore fisheries was run by the Lewis family in Lambertville, New Jersey, about ten miles north of Trenton. The Lewis's had been keeping annual records of catches since the early twentieth century. The number of shad they caught plunged from 3025 in 1942 to only 226 a year later. In 1949 Fred Lewis caught only three fish; in 1953 and 1956 none. See interview with Fred Lewis, November 18, 1988, Philadelphia Maritime Museum; *Philadelphia Bulletin*, June 21, 1944; March 30, 1949; January 17, 1950. In 1948 the U.S. Fish and Wildlife Commission estimated that the Delaware could carry between 15 and 20 million pounds of shad a year. See *Philadelphia Bulletin*, February 10, 1948.

44. *Colliers*, p. 53. On the construction and functions of new wastewater treatment plants see "The Southeast Sewage Treatment Works:

Start of Operations" (Philadelphia Water Department, December 30, 1955) and "Dedication Ceremony Northeast Sewage Treatment Works" (Philadelphia Department of Public Works, 1951). Louella E. Cable, "Pollution Problem in the Delaware River in Relation to Restoration of the Shad Fishery" (U.S. Fish and Wildlife Service, unpub. mss, 1945). M. M. Ellis, B. A. Westfall, D. K. Meyer and W. S. Platner, "Water Quality Studies of the Delaware River with References to Shad Migration," *U. S. Fish and Wildlife Service, Special Scientific Report No. 38* (Washington D.C.: Gov. Printing Office, 1947).

45. *Philadelphia Bulletin*, March 16, 1966. Population in suburban areas of the region increased from 970,000 in 1950 to 2.13 million in 1967. See Delaware Valley Regional Planning Commission, *The Regional Water Supply and Water Pollution Control Plans. Plan Report 4* (Delaware Valley Regional Planning Commission, 1969), 17.

46. *Philadelphia Bulletin*, April 28, 1966. The 1955 flood, which left 99 people dead and caused \$150,000,000 in damages, made flood control a major argument for completion of the dam, and opened the door to massive federal involvement in the Delaware River Basin. A comprehensive history of the dam and its defeat can be found in Richard C. Albert, *Damming the Delaware: The Rise and Fall of the Tocks Island Dam* (University Park: The Pennsylvania State University Press, 1987).

47. Anglers, historically, had never considered shad to be a good game fish. Most fishing manuals of the nineteenth century warned that it could only be caught in nets. Although fishing for shad with a rod and reel had taken place on the Hudson and Connecticut rivers since the 1870s, anglers on the Delaware did not begin to fish for shad until sometime around 1940. It did not emerge as a popular form of sport fishing until the 1960s. A. M. Spangler, *Near By: Fresh and Salt Water Fishing on Angling Waters Within A Radius of One Hundred Miles of Philadelphia* (Philadelphia: A. M. Spangler, 1889); *Philadelphia Bulletin*, May 20, 1954; May 28, 1969.

48. *Philadelphia Bulletin*, April 7, 1963; April 28, May 15, 1966.

49. Albert, 91-172.

50. Joe Miller and Arthur Lupine, "Angler Utilization and Economic Survey of the American Shad Fishery in the Delaware River" (unpub. report, Hellertown, PA: Delaware

River Shad Fisherman's Association, May, 1987). On the Brandywine see *Philadelphia Bulletin*, May 12, 1963; January 14, 1968; May 28, 1969; April 15, 1970. On the Susquehanna see Susan Stranahan, "Restoration Drama," *Philadelphia Inquirer Magazine*, (October 3, 1993), 16-21, 24-25, 28, and *Philadelphia Inquirer*, May 12, September 7, 1997. On the Schuylkill see *Philadelphia Bulletin*, April 3, 1973. On the Lehigh see *Pennsylvania Angler*, vol. 58:12 (December 1989); *Philadelphia Inquirer*, April 30, 1995.

51. Jim Merritt, "Shad By the Million," *Fly Rod & Reel*, (April 1992), 24, 77-78. Every spring the *Philadelphia Inquirer* and other newspapers in the Delaware Basin run articles celebrating the shad's yearly return to the river. For examples see *Philadelphia Inquirer*, April 9, 1989 and April 25, 1993.

52. On recent pollution problems in the Delaware see the articles in Shyamal K. Majumdar,

E. Willard Miller, and Louis E. Sage, eds., *Ecology and Restoration of the Delaware River Basin* (Phillipsburg, NJ: The Pennsylvania Academy of Science, 1988); K. S. Price and B. J. Dinkins, "Fisheries Fluctuations: Can We Separate Manmade Effects from Human Effects on Delaware Bay Fisheries," *Delaware Estuary Situation Report* (Newark, DE: University of Delaware Sea Grant College Program, 1986); Richard C. Albert, "Cleaning Up the Delaware: A 200-Year Effort." (unpub. paper) WRA/DRB Annual Spring Water Resources Conference, May 14, 1987; The Delaware Estuary Plan, *Comprehensive Conservation and Management Plan*, 195-218, and *Philadelphia Inquirer*, August 8, 1998.

53. *Philadelphia Inquirer*, May 7, 1989; January 14, 1992.

54. *Philadelphia Inquirer*, January 17, April 13, 1993.