

COMPLIMENTARY  
INAUGURAL ISSUE

■ THE SHAD FOUNDATION'S ■

# SHAD JOURNAL

*Managing hilsa: a case of mistaken identity*  
*Lessons of a 108-year-old shad fishery*  
*Shad and community culture*

VOLUME 1, NUMBER 1, NOVEMBER 1996

*President's Letter:*

## WHY A SHAD FOUNDATION?

In the summer of 1995, my colleague and I peered into a fish ladder through an algae-stained window, hoping to witness a great biologic event: the return of the Columbia River's Pacific salmon. The fish ladders at Bonneville Dam were in fact filled with silver migrants, but oddly, few salmon could be counted among them. Another fish—once foreign to the Columbia—accounted for the great silvery flood: the American shad.

Shad made their way to the Columbia after 1871 when Seth Green, the father of American fish culture, planted some fry in the Sacramento River, California. By 1938, when Bonneville Dam was completed and counts at the fishways were first tallied, only a handful of shad—some 5,000—returned alongside a total salmon population of half a million. Over the next 50-odd years, with further construction of Columbia dams, the shad count at Bonneville exceeded 3 million. These migrants, together with those spawning downstream of Bonneville, add to about 5 million, making the Columbia home to the world's largest American shad run.

Oh, stubborn nature! While folks on the East Coast struggle to save their shad runs, spending hundreds of millions of dollars on restoration, shad remain depleted. Similarly, on the West Coast, where over half a billion dollars is spent annually for salmon restoration, salmon runs—some declared officially endangered—remain depleted. But shad there thrive greatly. So vexing is this to managers of the Columbia's fisheries, that some advocate elimi-

nating American shad to the largest practical extent. Why? They fear a depletion of the food chain brought by the large increase in shad biomass.

Sports fishermen, some commercial fishermen (who now earn a living fishing for shad), and others, however, are opposed to eliminating shad in the face of limited scientific knowledge, particularly of the interactions between shad and salmon. They have a point. Compared to the thousands of scientific studies published on Columbia River salmon, those for the Columbia's shad can be counted on one's fingers.

### *Some advocate eliminating American shad to the largest practical extent.*

Spurred on by this imbalance and our discovery that there were 30 other recognized shad species world-wide—all valuable and interesting—my colleague, Curt Ebbesmeyer, and I have launched the Shad Foundation. It is a world-wide organization for people interested in shad. Its mission is to promote a greater understanding of shad for their restoration where depleted and their wise use where sufficiently abundant.

Why a Shad Journal? On a trip to the U.S. East Coast last April we met people who have devoted much of their lives to understanding shad. These people ranged from Richard St. Pierre, of the U.S. Fish

and Wildlife Service, who successfully pressed power companies to install fish lifts on the dams of the lower Susquehanna River, to Fred Lewis, the last licensed commercial shad fisherman on the non-tidal Delaware, who carries on the family's 108-year-old shad fishery. Each has a story foolish to ignore, and this journal is the place for them. It is for the fisherman, the scientist, the historian, the fisheries manager, the river user, and, yes, even the politician.

In this issue, biologist Mizanur Rahman recommends ways to improve the health of the hilsa shad fisheries in his homeland of Bangladesh. Fred Lewis, in an interview, draws from a lifetime of shad fishing on the Delaware and from the wisdom of his father who, in 1888, began a haul-seine shad fishery at the age of 13. Finally, folklorist Charlie Groth shows us how shad become entwined in a community's culture. When shad disappear, appear as exotics, or are restored, how does culture respond? She leaves the answers to us.

We encourage you, whatever your interest, to contribute articles, news items and opinions on any aspect of shad to the Shad Journal, and to become a member of the Shad Foundation. *-R. Hinrichsen*

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# Riders on the Storm

## *Better management of the hilsa shad of Bangladesh is needed to help feed a starving population*

by Mizanur Rahman

The summer monsoons blow warm, moisture-laden marine air over Bangladesh, dousing the land with rainfall and melting Himalayan snows. The ensuing floods overflow the Ganga (Ganges) River and its many distributaries, killing thousands of people annually. But they nourish, too. They carry sediments (alluvium) to farms, enriching their soils. They also attract a welcome visitor to Bangladesh's rivers: the hilsa shad (*Tenualosa ilisha*).

With one of the highest population densities of any country in the world, a rising birth rate, destitution, and hunger, Bangladesh desperately depends on this nourishment. Hilsa shad is a major food fish in Bangladesh and is sacred according to Hindu mythology. It is hailed in Bengali (Bangladesh's official language) as *macher raja-ilish*, meaning "hilsa shad—the king of fish." Its fisheries employ 40 percent of all fishers and, directly or indirectly, 2 percent of the entire country. Their proper management, based on a sound understanding of their life history, is therefore vital.

### Life History

Hilsa shad, like the American shad (*Alosa sapidissima*), is anadromous: it feeds and grows mainly in marine waters, migrating to fresh water for the express

purpose of spawning. Although migration distances of 50-100 kilometers (31-62 miles) are more common, hilsa shad are known to migrate 1,200 kilometers (740 miles) upstream to spawn in the Ganga system.

The hilsa shad deposits its eggs in fresh water; when they hatch, the larvae and juveniles migrate to sea over several months, feeding and growing en route. At this early stage of their life they are known locally as "*jatka*," and range from 4-15 centimeters (1.6-6 inches) in length. They are abundant from February to May in the foreshore and riverine waters of Bangladesh's deltaic rivers, including the Padma and the Meghna.

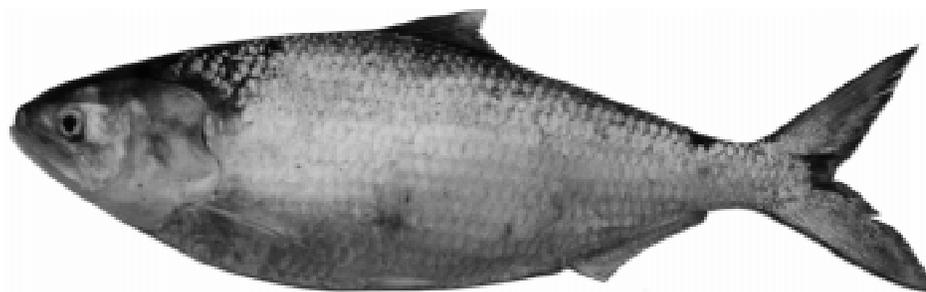
These juveniles are plankton feeders, eating blue and green algae, diatoms, and desmids from their phytoplankton menu, and copepods, cladocerans, and rotifers from their zooplankton menu. As the hilsa grow, they become mainly phytoplankton feeders; during their spawning migration, like the American shad, they cease feeding altogether.

### The *Jatka* fishery

Of special concern is the over-harvesting of these immatures. Currently, the catch of *jatka* is estimated at over 3,700 metric tons (4,080 tons) a year. Large numbers are intercepted in small-meshed current nets during their downstream

migration; near the sea shore, they are caught by artisanal fishers who mistake them for mature "*chapilla*," a similar fish known as the Indian river shad (*Gudusia chapra*).

The value of the hilsa shad fishery could be increased dramatically by simply protecting the juveniles. In fact, if 30 percent of the present catch were untouched, it could mature to an additional value of 5-7.5 million takas (\$120-\$180 million U.S.). Many, including the United Nations Food and Agriculture Organization (FAO), support a ban on *jatka* fishing during their seaward migration, especially in their nursery grounds. Two nurseries have been identified. The largest, on the Meghna River, extends from Shatnal south to Hazimara;



**HILSA SHAD (*Tenualosa ilisha*) is hailed as the "king of fish" in Bengali—the official language of Bangladesh. They are distributed from the Bay of Bengal west to the Persian Gulf.**

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### THE SHAD FOUNDATION

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*The Shad Foundation* is a non-profit organization that promotes a greater understanding of shad for the purpose of restoration where depleted, or their wise recreational or commercial use where abundant.

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**Submissions.** The editors welcome submission of articles on any aspect of shad. The Journal publishes letters, commentaries, histories, scientific articles, interviews, reviews, and philosophical and methodological items related to shad the world over. (See instructions on back cover.)



**ARTISANAL FISHERMEN make a haul in the Meghna river (left). Shad are dumped and processed at a landing platform in Chandpur (right). Much of the catch goes to waste due to lack of ice during the warm summer monsoons.**

the other extends from the Kuakata seashore in the Patuakhali district, to Dublar Char of the Khulna district.

To make a ban practical, fishers must be taught to recognize the difference between *jatka* and the Indian river shad (*chappilla*). *Jatka* has a shallower body, larger scales, and fewer than 70 scales along its lateral line, whereas *chappilla* has more than 100.

### Mature Hilsa Shad

Though hilsa shad is commonly available in the many southern districts of Bangladesh, most are netted at landing platforms within just two: the Barisal district located on the west bank of the Meghna River, and the Chandpur district, located on the Meghna's east bank. The marine catch is processed at Bangladesh Fisheries Development Corporation landing stations in the coastal cities of Chittagong and Cox's Bazar. At the time of peak catch, temperatures rise to 36 degrees Celsius (97 degrees Fahrenheit), and, because ice is in short supply (and transport

facilities are few), much of the catch is lost each year.

This waste is deplorable given the chronic starvation in Bangladesh. However, there are other, more fundamental reasons for hilsa shad declines. For example, the construction of the Farakka barrage (dam) in the Indian state of West Bengal blocked shad migrations, closing down the Goalundo Ghat landing station on the Padma River—once famous for its large hilsa landings. Dams, constructed to supply irrigation water and hydropower, not only block migrations, but they concentrate the shad attempting to swim upriver, thereby subjecting them to over-harvesting. Over the past 20-35 years, barriers have multiplied and the fishing methods have improved, but, amazingly, the hilsa endure. Always the survivor, they have responded by shifting their spawning migrations to the more eastern rivers of the Bay of Bengal.

### The Future

What steps have been taken to better

manage the valuable hilsa fishery? The Bay of Bengal Programme of the FAO proposes to: (a) educate fishing communities about the value of a ban on *jatka* fishing; (b) support a community-based program to monitor and enforce a *jatka* fishing ban on all major rivers during the *jatka* outmigration; and (c) establish, through field surveys, the downstream migration patterns of hilsa and their fishing mortality.

As for the hilsa adults, my recommendations are: (d) stop overfishing during peak spawning migration; (e) register non-mechanized fishing boats and regulate fishing gear; (f) estimate monthly landings for each locality; and (g) remove bamboo fences which fishers erect to block the hilsa's river migration.

Because management is best directed toward individual racial groups of hilsa, I further recommend establishing a thorough genetic analysis of hilsa shad. This analysis should be extended to differentiate genetically between shad species and subpopulations world-wide.

The pressure has never been greater to manage wisely Bangladesh's hilsa shad fisheries. Bangladesh has 125 million people in a total area of 144,000 square kilometers (55,350 square miles), making it one of the world's most densely populated countries. Already the land is pressed to the limit, with some two-thirds under cultivation. Rice is planted on 90 percent of this cultivated land and double and triple crops are planted where sufficient water is available for irrigation. Even this has proven insufficient to feed Bangladesh's growing population. We must find the will, perhaps born of our hardships, to protect the precious hilsa shad.

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### The Author

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# An Interview With Fred Lewis

*The Lewis Fishery, which turned 108 years old this spring, teaches us the lessons of history in managing shad populations, and the value of forging relationships between scientists and fishermen*

by Richard Hinrichsen

Each spring, at the annual Shad Fest in Lambertville, New Jersey, Fred Lewis claims his two days of fame. The festival, timed to coincide with the heart of the American shad run up the Delaware River, lures folks who travel from all over the United States to enjoy the beautiful setting, the flea market, and delicious foods—including barbecued shad. But what leaves perhaps the greatest impression is Lewis' 108-year-old Delaware River shad fishery.

The fishery is located on the south end of Lewis Island, adjacent to a shallow pool about two miles long and about a quarter-mile wide at the bridge which connects Lambertville with New Hope, Pennsylvania. As my colleague, Curt Ebbesmeyer, and I crossed the bridge from the New Hope side, we peered upriver into the past to see a team of fishermen rowing shoreward, deploying a haul-seine to catch shad migrating up the Delaware.

This method of fishing differs little from that employed in the 1830s by Samuel Ladd Howell, M.D., whose family owned the Howell and Fancy Hill fisheries downstream of Lambertville [see side-bar, "Haul-seining the Delaware"]. "It is an interesting sight to witness these operations..." wrote Howell, "to see the water within the seine black with their backs and bristling with their fins—to witness the animation and bustle of the fishermen, and behold their eagerness and anxiety to secure their booty, are circumstances calculated to excite in the spectator of such an enlivening scene, emotions of delight, and cause him to participate with the successful fisherman in all his joy and hilarity."

Although the catches do not number in the thousands as they did in Howell's day (Howell once witnessed the landing of 10,800 shad in a single haul), haul-seining still attracts excited onlookers—both by

day and all hours of the night. Children shriek with excitement at the splashing, even when the seine captures just two shad and a common carp, as it did on our day at the fishery.

## The Mysteries

For two Seattleites travelling east to explore the roots of their large Pacific coast shad runs, it was an unequalled opportunity to see the fish through the eyes of one intimately familiar with the early boom-bust cycles of the Atlantic coast shad fisheries. Some of the questions foremost on our minds were: What happened to the American shad populations of the Delaware? Where have all the commercial fishermen gone? Why does the Lewis Fishery perse-

vere? Are there lessons from the East Coast that we can bring back to the West Coast?

As we descended the bridge into Lambertville, I fumbled with my cassette recorder while Ebbesmeyer found his way through the crowd and introduced himself to fishery leader (or traditionally, "captain") Fred Lewis. Now in his 80s, Captain Lewis appeared younger than his age but spoke with the assurance of over 50 years of haul-seining. His body appeared as a product of his work. His skin had been weathered by the sun and water while working hard at the fishery, seining the Delaware again and again. His mind too appeared honed by the fishery—the daily decisions about when to fish, the effort needed, and the market. But these days



RICHARD HINRICHSEN

**FRED LEWIS (right) explains commercial haul-seining to the author's travelling companion, Curt Ebbesmeyer (left). Lewis' fishery, begun by his father at the age of 13, has endured for 108 years on the Delaware River at Lambertville, New Jersey.**

# Haul-Seining the Delaware

From the writings of Samuel Ladd Howell, M.D., published in the *American Journal of Arts and Sciences* in 1837

The net is placed on the stern of what is called the seine-boat—a large barge-like boat, long and narrow, and having a sort of platform in the stern, upon which the net and lines are carefully coiled. The boat being rowed to the proper starting place, and the line which is to connect the net with the shore is then taken by a part of the crew, called the landmen, who are posted on the shore at the starting place, and the boat is rowed out into the river, the residue of the land line and the net gradually running off as the boat recedes, until the whole is dropped into the water, the boat gradually rounding to and approaching the shore, so as to give to the net the form of crescent, the arms of which being in the direction of the current, so as to gather in as many fish as possible during the drift of the seine. On reaching the shore, the boat's crew seize the line connected with the outer end of the net, called the water line, which was also coiled away in the boat, and both divisions of the crew now commence drawing in their respective ends, gradually "dropping down," as it is called, so as

to keep "abreast" of the drifting seine, until each is finally brought to land; when the two ends have reached the shore, the fish are completely enclosed.

The next process is called landing; to effect this, the men at each end lay hold of the cork and lead lines of their respective ends, and draw them together, pulling as uniformly as possible so as to keep up a simultaneous movement, the lead line of each end being kept near the bottom by a "holder down," as he is called, whose duty is to press down this line with his foot, allowing it to slip at every pull of the men who are drawing the net. In this way they soon reach the central part or bag of the seine, when those pulling upon the sunken line necessarily meet, and the contents of the net become enclosed within a small



**THE FISHERY CREW "bags up" the shad catch, and begins bailing—transferring the shad from the seine to a shed to be sold. Little of the fishing method has changed over the last two centuries.**

space between its marginal lines; this is called bagging up. It now only remains to transfer the fish into the market-boat, which is effected by means of scoop or hoop-nets—small hand-nets, managed by a single man, and capable of holding about twenty fish, and this is called bailing.

Lewis mostly labors at the fishery in a different capacity while his grandson, Steve Meserve, 35, leads it into the next century. As a guru of the Delaware River shad, Lewis talks to recreational fishermen, biologists, tourists, and television reporters alike about the fishery's history, reasons for past declines and sporadic resurgences of the Delaware shad. He also talks with pride of his father, who began the family fishery.

## The Fishery Past and Present

"Shad fishing on the Delaware used to be a big business back in the late 1800s," said Lewis. "They caught as many as 50,000 right out of this pool. There were five fisheries in here at that time." He shows us their locations: one on both ends of Lewis Island, one directly across the river from the island, and one on each bank below the bridge at Bridge Street which we had just crossed. "Five of them," he repeated. "When all of these fisheries were

in operation, you had to watch when you mis-started your haul—you'd be fishing in somebody else's water. In 1896 they each caught more than 10,000 shad apiece. At that time they shipped them to New York and Philadelphia. We don't do that anymore."

His dad, William P. Lewis, or Captain Bill, as he was known locally, started the fishery in 1888 at age 13, and continued it for 73 years. He died in September 1961, when shad young were migrating from their nursery grounds to the sea. After his father's death, Lewis became the fishery's leader.

"When it was a business, you fished 24 hours a day if you had to. The longest day I ever put in was between midnight Sunday night and 4 o'clock Wednesday morning. That was a *long* day." I asked if there were a lot of fish coming in to keep him out that long. "Not too many more than what we're doing now," he replied. (Later, we would find that he caught only 241 this year, which he said was his lowest in the last 25

years.) "Since 1975 we've only had two years that we've been below 1,000 shad and we were only fishing a third of the time we would normally fish," said Lewis. "We don't usually fish in the mornings here at all during daylight; we usually fish in the evenings from 5 o'clock until about 8.

"We did a haul about every hour," he continued. "Most of the time you were hopin' that somebody would come along and say, 'I'll row for you this haul.' My brother Bill was an expert net hanger. What we used to do for Dad at that time—we didn't have all these synthetic ropes that we have now—you had to 'rehang' the net about twice a week. You'd have to hang it on Saturday at 2 p.m. and then again on Wednesday." Lewis explained that hanging was a kind of net repair. "The webbing is fastened onto the ropes. You have to change what's called the seaming twine. We were using line or cotton. It would wear out after 30-40 hauls. At that time that was just a headache. The seaming would get so bad that finally you'd have to

say, 'well, we've got to rehang it.' That would take a good hour or hour and a half—you would lose a haul or two."

Amazingly, the work at the fishery has changed little since Lewis' father began the fishery. "We're fishing the same way," said Lewis, "doing the same things they did. But I don't think we're doing it as efficiently. We used to have a boat that was 32 feet [9.75 meters] long and three men would row it. They were also making a bigger haul than we'd make now—they were fishing two fisheries as one."

### Stricter Tax Laws

"Is the money you get enough to keep up with the taxes?" asked Ebbesmeyer.

"No, it doesn't even pay that," Lewis answered. "We are in the hole for sure. We sell the shad on the shore here to buy new nets or get the boat repaired or pay the taxes on the land if we get enough money, which has never happened. The taxes are so high.

"In 1943 the Internal Revenue Service told my father he could no longer take the losses incurred by the fishery from his income. At that time if you had a loss in one area, you could take it off of your total income. So they told him, 'well, you can't do that anymore. After three years of losses, it's considered a hobby.' So ever since then, we've been a hobby. A lot of affluent people were buying up plots and taking losses on their farms and applying it against their income. The IRS got wise to that." The tax laws, forged to prevent tax evasion, hurt the commercial fisherman.

### A Fickle Market

Lewis battles a fickle fish market. "The gillnetters are still fishing. Not so much for shad as for other fish," said Lewis. "They don't really make an effort to catch a lot of shad because as soon as they catch a lot, the price in the market goes down and it's not worth catching them."

Shad fishermen on the Delaware are at a disadvantage. Due to a biological quirk, shad run earlier in more southerly rivers, allowing southern fishers to prosper most. "They get their fish in the market earlier and get a good price for them before the fish are caught up here. Their advantage. People get hungry for shad early. Shad is better earlier than later."

Lewis' approach to the shad market betrays a strong conservation ethic. "We



RICHARD HINRICHSSEN

**SPORTS FISHERMEN angle for shad downstream of the Lambertville-New Hope bridge. On this April day they have more luck than the professionals at the Lewis Fishery.**

don't try to catch enough even to sell to the markets of Philadelphia and New York," said Lewis. "We try not to catch more than we can sell right here. For the price you get in the markets, the fish are more valuable going up the river. A shad roe [a female] that you might get 50 cents a pound for in the market, might spawn 150,000 eggs. Big difference in value there."

### Tightening Regulations

Fishing regulations have helped preserve Delaware shad. For at least a century, the legal shad season has closed on June 10 and there have been weekly weekend closures lasting 27-34 hours. "We have to quit at 2 o'clock on Saturday afternoon and can't put a net back into the water until midnight Sunday," said Lewis. "No fisherman ever objected to that law." To the Lewis' good fortune, the weekly closures allowed fish to escape the downstream fisheries on the weekend to arrive at the Lewis Fishery when the river was opened early in the week. "We looked at the old records and saw that the good days were Mondays and Tuesdays," said Lewis. "By the end of the week, you would be down to pretty much nothing."

Now, with a surge in conservation awareness, regulations are tightening. "I think the biggest regulation they put into effect on this management program was that you have to apply for a permit to fish commercially each year," said Lewis. "And we're the only one that has a permit. I think they are in the process of deciding if you haven't fished in the last five years, you can't get one. That's to prevent new commercial fishing businesses from coming in. They did that on the Hudson several years ago. Shad are becoming more of a sports fish. Pennsylvania has even set a limit on them to six a day. There are no

commercial fisheries in Pennsylvania on the Delaware, or for shad, anywhere in Pennsylvania. There used to be a big run on the Susquehanna River but that's stopped now, too."

### A Lethal Barrier

Why the declines in commercial fishing? "By the early 1940s, the shad had been depleted to the point where it wasn't profitable," explained Lewis. "All the rest of the fisheries quit and Dad kept on fishing. He was sure they'd come back. They found the source of the pollution that was keeping them out down around Philadelphia."

Lewis is referring to a pollution crisis that devastated the shad and outraged many. On May 28, 1933, Frank H. Stewart, president of the Gloucester County Historical Society, wrote, "[I] walked down the beach of the cove and found it strewn with tens of thousands of pounds of young herring the size of shiner bait, a quantity of full-size herring, a number of catfish and an occasional rat. It seems that nothing that swims can now live in the putrid river which stinks like an overworked sewer."

In the 1940s M. M. Ellis and others discovered that the Delaware contained an oxygen-depleted lethal barrier to shad which was 50-70 miles (80-110 kilometers) long. Shad suffocated before reaching their destination—be it the spawning grounds for the adults, or the sea for fry and spawned-out "down-runners."

A photograph of the shad carnage appeared in the *Camden Courier-Post* on May 23, 1951. It pictured an elderly man grasping a dead adult shad by the tail, holding it in disgust over a bank lined with shad carcasses. These decaying shad had spent 3-8 years harvesting the abundance of the sea, avoiding nets and predators, and even-

tually finding the Delaware for their return migration, only to suffocate before given a chance to spawn.

Despite the chronic pollution, Lewis' father remained optimistic. "Dad was always confident that shad would come back. He said, 'You clean up the river, they'll make it.' In 1953 and 1956 we didn't catch any shad at all. All through the decade of the '50s, I don't think we caught more than 90 fish in a season. And when they started to clean that up [the river around Philadelphia], they cleaned up this end of the river too and the shad took care of their own repopulation. In '63 we had a big year. We caught almost 4,000 shad."

### A Valuable Partnership

Over the years, Lewis has developed a sense of shad biology by doing what best defines the word "naturalist"—observing nature first-hand and thinking hard about it. He shows us that biologists could do better by leaving the office to observe the river and talk to fishermen. One biologist who did this was Mark Chittenden. Forming a partnership with Lewis, he conducted the scientific studies that helped save the shad.

Their partnership was forged in the spring of 1963, when Chittenden, then a 23-year-old Ph.D. student, asked Lewis to help him study the Delaware shad. Lewis, his brother William Jr., and his nephew Cliff showed Chittenden how to seine. Together, they collected samples that Chittenden would use to determine the timing and size of the spring run, its sex, age, repeat-spawner composition, condition and gonad development, and spawning grounds. Chittenden also fished for juveniles to determine nursery areas and the timing of the first seaward migration. In the lab, he determined the shad's oxygen, salinity, and temperature requirements.

"They allowed me to collect fish at that fishery using my own nets," said Chittenden. "Fred and Bill—Bill died within a year or two after I first met him—showed me how to operate a big haul-seine which I obtained from the Division of Fish and Game. They helped me land the net from time to time, and gave me unrestricted access to that unique location."

Lewis smiles recalling Chittenden's adventures with a haul-seine. "Mark learned a lot by trial and error," recalled Lewis, "by falling into the river a lot of times—having the rescue squad come and get him. He jumped out of the boat, thought that he

could hit bottom, but couldn't. He tried to use too much net with too few men sometimes."

The Lewises also provided historical fishery records. Lewis' father had kept annual records of the fishery since 1888, which Chittenden used to reconstruct a run history.

After seven years' work, in 1969, the 29-year-old Mark Eustice Chittenden Jr. earned his Ph.D., and wrote the treatise "Life History and Ecology of the American Shad, *Alosa sapidissima*, in the Delaware River," a 460-page dissertation. (A wiser Chittenden, now 57, says it would have been better said in 200 pages). Despite its age, the work is frequently cited, and is to date the most definitive study of the Delaware River shad. Lewis agrees, calling it "the masterpiece of shad information."

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***"Dad was always confident that shad would come back. He said, 'You clean up the river, they'll make it.'"***

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Chittenden drew many conclusions that were essential to the successful management of shad on the Delaware:

(1) In the fall, the young were driven by cool upstream temperatures into warm, but lethal, oxygen-depleted waters near Philadelphia. This, he concluded, not the deaths of the adults, was the main reason for the depleted runs of the 1960s.

(2) Only a small portion of the historic spawning grounds was contributing to shad production. The largest contributors were spawning grounds far upstream in the vicinity of Hancock, New York. Shad which attempted to reproduce in downstream locations reached the Philadelphia-Camden area early in the fall when oxygen levels killed them.

(3) Exotic fish introductions played little or no role in the shad's decline at the turn of the century, nor did the illegal eel baskets, which trapped shad young.

(4) The proposed construction of the Tocks Island Dam would likely extirpate shad if fish passage facilities were not provided or were unsuccessful.

(5) Cold water releases from reservoirs

hurt shad production. Cannonsville Reservoir, which started cold releases in the West Branch in 1963, halted spawning.

In the end, good science won out. "They didn't put the dam in [at Tocks Island]," said Chittenden. "They improved the water quality enormously down in the lower Delaware Basin based upon my dissertation. They put a quarter of a billion dollars into it. There was a block of almost no oxygen in there [the part of the Delaware River adjacent to Philadelphia] 70 miles (113 kilometers) long for most of the year. It was horrendous."

### Other Partnerships with Biologists

Lewis continued to assist researchers. Throughout the '70s and '80s he worked with biologists to estimate the shad population in the Delaware River by mark-recapture methods. This continued until a hydro-acoustic system was installed, automating the shad counts.

He also helped Canadian investigators. "We fished for the Canadians on Easter Sunday one time," he recalled. "The crew got together and made a haul and we caught 45 fish [for Dr. Dadswell of the Canadian Department of Fisheries and Oceans]. I said, 'You want to make another haul, don't you.' He did. So we went and made another haul and caught 125. We took 5 fish [making the total sample size 50 as required] and dumped the rest back. Those guys from Canada couldn't believe it. They said 'it's the first we've seen commercial fishermen put fish back.' But that's not unusual here."

Dr. Dadswell was collecting blood samples of fish all along the East Coast from Florida to the Bay of Fundy, located off the coast of New Brunswick, Canada, to find genetic markers that would allow him to identify individual stocks.

"He figured he could tell from his studies where the fish came from that went up there [to the Bay of Fundy]," explained Lewis. "Canada was thinking of building dams on the tributaries to the Bay of Fundy which took advantage of a 40-foot [12-meter] tide. Dadswell said that was going to interfere with the shad up there. He wanted to show them that it wasn't just a Canadian problem—it was an international problem." Amazingly, Dadswell caught shad in the Bay of Fundy that originated in the Delaware River and visa versa. He demonstrated that shad honor no international boundaries.

## Lewis Questions Conventional Wisdom

Although biologists have forged a partnership with Lewis, they have not always listened closely enough to his observations. He questions the notion that shad begin their ascent of rivers only after three or four years. “We’ve fished with a five-inch mesh net for a long time, that’s what we use as a shad net. Part of this net is 5 inches [12.7 centimeters], and part of it’s 3 inches [7.62 centimeters]. After the State started to tag them in the 1970s, the biologists kept saying, ‘you don’t see any little shad up here, ‘cause they don’t come back ‘til they’re three or four years old.’ I said, ‘Oh no, Joe, we’re gonna show you something next year. I’ll get a 3-inch mesh net and then we’ll show you the little shad.’ So every year that they tagged, and ever since then, we’ve been using the small meshed net and we’ll get shad that are only *that* long.” He indicates about a 6-inch (15-centimeter) shad with his hands. “A yearling. They just naturally follow the spawning group coming in. After the adults spawn, they turn around and go back with them.”

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***“There were all kinds of methods of hatching them and placing the fry at the upper end of the river. That didn’t help much. When they cleaned up the pollution the fish came back.”***

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Lewis believes that introduced exotic fish, contrary to Chittenden’s findings, do deserve some blame for shad depletions. “They’ve introduced so many predators into the river,” said Lewis. “The first one they put in here was what they called Susquehanna salmon—the walleyed pike. They put them in here back in the teens and they began eating up the little shad. And they put in the muscalonge. The tiger muskies. Cutthroat trout. Atlantic salmon used to come up here too, but they don’t anymore. All the biologists say we’re too far south. But they used to come here.”

He questions the method for rehabilitating the Susquehanna River shad runs which must pass several power dams on

the lower river before reaching their historic spawning grounds. These dams include the 96.5-foot-high (29 meters) Conowingo project located just 10 miles (16 kilometers) upstream of where the Susquehanna empties into Chesapeake Bay. When I pointed out that fish lifts are nearly complete on three of the main stem dams of the lower Susquehanna, Lewis replied, “Yeah, but they make no provision for the little ones to get back! They have to go through the turbines.”

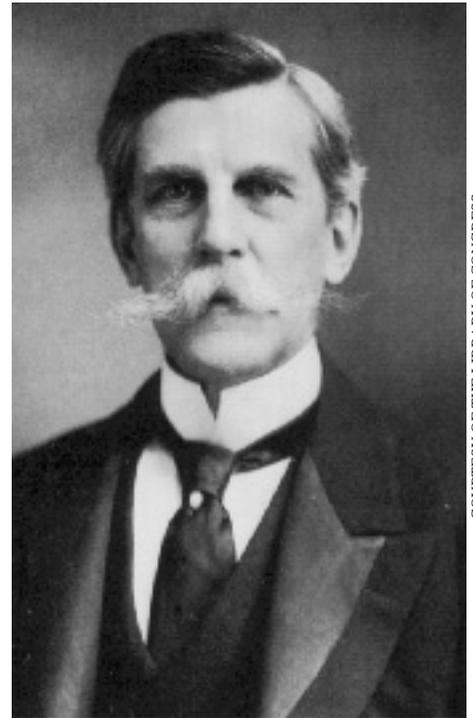
I argued that the Columbia River has several power dams with fishways for upstream migration and that shad there are prospering. “How far is the first dam from the ocean?” he asked. I admitted that the first dam, Bonneville, is 146 miles (235 kilometers) upstream of the Columbia’s mouth. “That’s far enough up that they’d spawn below that,” he argued. One wonders, however, why shad are successful upstream of Bonneville (with runs numbering 2-4 million) if turbines are so destructive to juveniles.

Lewis is also skeptical about the benefit of hatcheries, placing more trust in the shad’s innate ability to choose mates and reproduce. “They had all kinds of stocking programs,” said Lewis. “They’ve done all sorts of things to try to increase the population. Dad said that shad would take care of themselves. They tried to replace the stocks here on the Delaware many times with hatchery fish. Hatching them right here. There were all kinds of methods of hatching them and placing the fry at the upper end of the river. That didn’t help much. When they cleaned up the pollution the fish came back.”

### Supreme Court Battle

Fred talked more about his father and the old days. In little notebooks, Lewis’ father kept accurate—if cryptic—records of the daily catch. “He testified in the Supreme Court that we needed the flow of water down here to get the shad up. The New York lawyers ridiculed his daily catch records, but the presiding judge said ‘Mr. Lewis, do you understand what your records mean?’ Dad said ‘Yes.’ ‘That’s all that’s necessary. If you understand it, that’s the only man that has to.’”

Lewis’ father was testifying on behalf of New Jersey in the case of the State of New Jersey, Complainant, v. State of New York and City of New York, Defendants, with the Commonwealth of Pennsylvania



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**OLIVER WENDELL HOLMES JR., justice of the U.S. Supreme Court, declared that “A river is more than an amenity, it is a treasure,” in the Court’s opinion in *New Jersey vs. New York*—a riparian rights battle fought over the Delaware River. In the case, Lewis’ father testified that the shad needed the Delaware flows to migrate upriver.**

as an Intervenor [see *CASES ARGUED AND DECIDED IN THE SUPREME COURT OF THE UNITED STATES AT OCTOBER TERM, 1930*, Vol. 283, pages 336-348]. It was a suit filed in the U. S. Supreme Court by the state of New Jersey for an injunction against diversion of water from the Delaware River or its tributaries by the state and city of New York for their increasing water demands.

“They had to go to the Supreme Court, no state court could handle it,” said Lewis. “They sent [Charles Burch] down to Trenton here to hear the case.” Burch, from Memphis, was appointed special master by the court to hear the case and report back with recommendations. The Chief Justice, Charles Hughes, could take no part in the decision of the case because he, a New York native, had been paid \$10,000 by New York City to write an opinion on the dispute before he was appointed to the Supreme Court. He had opined that the Supreme Court would not grant an injunction prohibiting the progress of New York’s diversions.

Lewis’ father testified before the special master in good company. On April 24,

1930, Professor H. K. Barrows of the Massachusetts Institute of Technology, also testifying for New Jersey, introduced charts and graphs illustrating that the diversions proposed by New York would seriously impair the river's flow.

Barrows presented a map 20 feet (6.1 meters) long that showed the effect of the proposed diversion on the Delaware for 225 miles (363 kilometers). To calculate water velocities for his map, he had floated oranges from Pond Eddy to the Delaware Water Gap. The oranges' trips varied from 90 to 205 hours, depending on the river's level, giving velocity estimates of 1-2.5 miles (1.6-4.0 kilometers) per hour. New York withdrawals, he concluded, would slow the flow—a flow upon which aquatic life, including the shad, depended for survival.

Lewis' testimony did not convince the special master that the proposed flow reductions would harm the shad. Burch wrote that "the taking of 600 millions of gallons [2,271 millions of liters] daily from the tributaries would not materially affect ... the fisheries for shad," but he did believe that the withdrawals would increase the salinities of the river, harming the oyster fisheries. The effect of the proposed withdrawals, he reported, would be "greater than New Jersey ought to bear," but the harm could be avoided by reducing the draft of New York to 440 million gallons (1,665 million liters) daily.

The Court agreed. They decided on May 4, 1931, to deny the injunction against New York's diversions, but limit them to 440 million gallons a day. Writing the Court's opinion, Justice Oliver Wendell Holmes declared that "A river is more

than an amenity, it is a treasure. It offers a necessity of life that must be rationed among those who have power over it. New York has the physical power to cut off all the water within its jurisdiction. But clearly the exercise of such a power to the destruction of the interest of lower States could not be tolerated." Both sides hailed the Court's opinion as a victory.

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***"A river is more than an amenity, it is a treasure."***

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The Court put the onus on New York to maintain a flow of 3,400 cubic feet (96 cubic meters) per second at Trenton. But nature obeys not our laws. New York, according to Lewis, "tried to do it until we got a bad drought. They depleted the main reservoirs trying to maintain it. So they appealed it to the Supreme Court and then they changed it so that they have to maintain 1,500 cubic feet (42.5 cubic meters) per second just below the New York State line.

New York's argument then was that they were supplying *all* the supplemental water—New Jersey and Pennsylvania weren't supplying anything. They had no dams to supply it. So the Supreme Court said 'You keep it at 1,500 cubic feet (42.5 cubic meters) per second below the state line and you're O.K.' And that's what New York maintains today."

Lewis seems to sympathize with New York's complaint. "Before they built the dams," said Lewis, "the flow would get much lower than 2,700 cubic feet [76.5 cu-

bic meters] per second. Sometimes here in the summertime 75 percent of the water down here is from those dams in New York." But he defends the requirement as retribution. "They took away some of the spawning grounds for the shad when they built those dams. On the West Branch of the Delaware [which has its mouth near Hancock, New York], shad won't spawn because they have bottom releases out of the dams and the water is too cold."

### **We Take Our Leave**

Our half hour with Fred was up, and we had answers to our questions, but they had multiplied, leaving veins of research for future mining. We wondered if after the Delaware River pollution was cleaned up and the American shad rebounded, did shad in neighboring rivers show increases?

If so, perhaps restoring shad to the Susquehanna River—the mother river of the Chesapeake—would increase shad populations in other Chesapeake Bay rivers. So goes the Susquehanna, so goes Chesapeake Bay?

I grasped Lewis' hand, shook it, and told him that meeting him was the highlight of our trip to the East Coast. "I certainly hope not," he said.

With that, we started for the Lambertville Station restaurant to try their "Blackened Shad" and "Shad Roe Wrapped In Bacon." As we departed, the shore crew gathered the next catch, children squealed with delight at the flopping fish, camcorders whirred, and a train whistled and rumbled its way through Lambertville, slowing only briefly on its run up the Delaware.

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### *The Author*

Dr. RICHARD HINRICHSEN is a Research Consultant at the University of Washington in Seattle, Washington, U.S.A., where he currently studies century-long trends in climate and fish production in the Northwest. He is serving as president of the Shad Foundation and is working with oceanographer Dr. Curt Ebbesmeyer to understand the rapid spread of American shad up the Pacific coast of North America from the Sacramento River, California after 1871. For further information, contact the the author at hinrich@cqs.washington.edu.

### *Further Reading*

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# The Lewis Shad Fishery and Community Culture

*In Lambertville, shad are integral to the community's culture*

by Charlie Groth

As a folklorist, my primary interest in shad fishing is cultural, and the Lewis Fishery on the Delaware River provides a wonderful example of occupational and family folklife. By examining the practices surrounding the fishery, we see how members of various regional communities develop, maintain, and express their culture.

I began my fieldwork with three interviews of Fred Lewis, who has spent most of his 80 years working around the fishery. He cited events, names, places, dates and methods dating back more than a century to describe fishery practices. My first day of field notes contains themes that would reappear over the next three months of study: self-reliance, experimentation, making the best of materials at hand, and cooperation and interaction among many small communities. On day one, I observed the 6-8 person crew rebuilding the bridge to the island assisted by a local rowing club that stores equipment there. Winter floods destroy the bridge so frequently that the crew designed it to wash up on the island instead of floating downriver, allowing them to use the remains to build a new bridge.

At the outset, I expected to learn about the Lewis-Meserve family as a community and the crew as a second community, followed by townspeople interested in the fishery, and visitors to the town's annual Shad Fest. I was taken by surprise by an entirely different community: the fishery's customers. Customers return year after year to buy shad and chat with the family, crew, and each other. At the fishery, many who cross paths do so only during shad season. Conversation frequently turns to the signs and activities of spring, which shows that, for many, buying and preparing shad is one way they celebrate the coming of the season. Many of them drive more than an hour to visit Lambertville, and some have been coming for more than 20 years.

When I watched hauls on weekday eve-

nings or Saturday mornings, I asked customers how they learned about the fishery, how long they had been coming, and how they prepared shad. From these customers, I learned what the shad fishery meant to diverse populations, particularly through their "foodways"—cultural expressions related to food. The fishery has long adapted its procedures to match the customers' cultural needs. For example, a "live box" floats half-submerged to hold living fish so that Orthodox Jewish customers can take home live fish to prepare according to kosher law. Once they bring the shad home, customers from various ethnicities prepare them according to their families' cultural norms. Asian customers serve shad steamed, with steamed or stir-fried vegetables and rice. Indian customers adapt old customs when they buy American shad, for in their homeland, people steam a similar species with banana leaves. European and African-American customers are more likely to bake, grill, or fry shad and serve it with potatoes.

As well as reflecting broader cultures, the Lewis Fishery reflects the values of the family. One such value is self-reliance. Little is wasted. For example, their current haul-seine boat is a refit W.W.II boat abandoned by the Corps of Engineers in the 1960s. The family also values fairness. Their method of sales reflects this concern, and highlights the leadership of Nell Lewis, Fred Lewis' wife, who has parted from William Lewis' informal method of assessing shad prices on the river bank. Instead, Nell and other women in the family sell shad in the space underneath the fishery's cabin. They have adopted a first-come first-serve business practice and flat prices to distribute the catch equitably among customers.

I also discovered an occupational culture with its own vocabulary. The word "bushwhacker," for example, derived to describe the Native American practice of beating the water with brush to corral shad,

applies to commercial haul-seine fishers and their nets. The term "giffen" (pronounced "jiffen") describes shad under three pounds which were once thrown in free with large orders. With the decline of commercial haul-seine fisheries and the size of shad—most of the buck shad now fall within the giffen range—these terms are falling out of use.

Despite many changes, the Lewis-Meserve extended family and the crew—most but not all connected with the family—still go out each evening after their work days to haul, for the shad fishery has a vital position in family and local culture. With declines in the shad population, the fishery has adapted. In past years when the shad population was strong, William Lewis would leave his full-time job for several weeks each spring to fish full-time. Now, as in the past few decades, crew members hold full-time jobs year-round, fishing only in the evenings and on Saturdays. The present leader, Steve Meserve, works full-time as a computer programmer, but on the island, he turns to the traditions of adaptation, experimentation and self-reliance; he reads the river, blacksmiths, knits and mends nets. As Meserve says, "We do a lot of things temporarily that last a long time." Through this perseverance, the haul-seine shad fishery culture endures on the non-tidal Delaware.

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## *The Author*

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## Shad Bites

### Gizzard Shad Attracts U.S. Symbol

Last year, due to climbing population numbers, the United States's national symbol, the bald eagle, was stricken from the "endangered" list. These magnificent birds now flock in great numbers about lakes and reservoirs in the midwest states, where several nesting pairs are now observed. What has brought these majestic scavengers in such droves?

In part, the gizzard shad. Introduced to U.S. waterways as a forage for game fish, they have also created a forage base for eagles and other avian predators. Rick Seward, Game and Parks Commission conservation officer in central Nebraska, explained that the Calamus Reservoir in Nebraska has undergone "a biological change for the better" in the past few years. Gizzard shad were introduced into the lake and their population exploded. These shad die off naturally every winter, providing abundant food for the eagles to scavenge on their journey northward to Great Lakes breeding areas.

On the Wisconsin River, eagles flock to Prairie du Sac Dam, where waters teem with fish throughout the winter. On the Mississippi, many eagles gather at the Melvin Price Locks and Dam at Alton and

Locks and Dam 24 at Clarksville. "What we're witnessing here is a rebound of the bald eagle," said Jim D. Wilson, state ornithologist with the Missouri Department of Conservation. "Last year, we had more than 2,400 wintering bald eagles in Missouri alone. In the late 1970s, we had 500 or 600." □

### Floods Damage Shad Facilities

The East Coast winter floods wreaked havoc on fish facilities in the Delaware and Susquehanna rivers this year.

On the Delaware, a crew waited until April for the river level to drop to scoop up 500 to 600 tons of silt from a fish ladder at Easton Dam. This ladder and one at Chain Dam, upstream of Easton, were completed in 1994 at a cost of \$3 million. They allow American shad and striped bass to migrate up the Lehigh River, a tributary of the Delaware. According to Ken Lewis, superintendent of Delaware Canal State Park, workers had just two weeks to get the ladder open before the shad arrived.

The ladder's opening chamber, about 100 feet long, 13 feet deep, and 10 feet wide, was filled to the top with river gravel and debris. "The river stayed up for so long that we couldn't even get in there with equipment," said Lewis. "It wasn't until later in April and early in May that we ac-

tually opened it up and it was mostly *hand* digging."

Despite the damage, shad returned to the Lehigh in record numbers. According to Lewis, 1,200 shad were counted over the ladder this year, compared with 900 in 1995 and 89 in 1994—the first year of operation. The shad were aided by fast digging and cool weather. The cold delayed the upstream shad migration, buying workers time to clear the Easton ladder.

On the Susquehanna, a coffer dam was swept away at Holtwood Dam, delaying construction of the long-sought \$20 million shad fish-lift by about a month. The lift is due to open before the shad run of 1997, but with a month less for calibration. □

### Connecticut River Coordinator Named

Janice Rowan, a 13-year fisheries biologist with the U.S. Fish and Wildlife Service (USFWS), was named Connecticut River Coordinator this year. As coordinator, she directs restoration programs for American shad and Atlantic salmon. Previously, Rowan served as deputy associate fisheries supervisor at the USFWS' Northeast Regional headquarters in Hadley, Massachusetts, where she had worked since 1992. □

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