“Marvelous... Egan's book is an ecological page-turner.”
—John Hildebrand, Milwaukee Journal-Sentinel

“This is a rollicking, eye-popping, scary, sad tour of one of the world's watery wonders, the Great Lakes.”
—Stephanie Hemphill, Agate magazine

“With narrative flair, Dan Egan tells the story of how it is that we can be so shortsighted and negligent when it comes to something as wondrous and essential as our Great Lakes and yet so industrious and inventive in trying to undo our mistakes. This is essential reading for anyone concerned about the future of our natural world.”
—Alex Kotlowitz

“In this beautifully vivid portrait of the Great Lakes, Dan Egan explores one of America's most essential ecosystems, reminding us that its story—one of both harm and hope—is ultimately our own.”
—Deborah Blum

“A masterpiece. Dan Egan's epic story is one of those rare books that can change the world. Rachel Carson's Silent Spring sparked a national revolt against toxic pesticides. Egan's work could help save the world's biggest body of fresh water. Read it if you care about this country—and our planet.”
—Tim Weiner
Chapter 5

CONTINENTAL UNDIVIDE

ASIAN CARP AND CHICAGO’S BACKWARDS RIVER

The words “continental divide” conjure images of a cloud-scarp-ing mountain crest stretching like a spine down the middle of North America that forces raindrops and melted snow to flow one way or the other—down a western slope and out to the Pacific Ocean or down the other side toward the Atlantic. But a similarly important continental divide runs right through the western edge of downtown Chicago—the one that splits the Mississippi River basin from the waters of the Great Lakes.

The Mississippi River drainage basin covers about 40 percent of the continental United States, stretching from Montana to New York to Texas. This means that the streams, creeks and rivers in the 1.2 million square-mile expanse that is roughly the size of India flow downhill into the Mississippi River and out to the Gulf of Mexico. The Great Lakes basin, which straddles the U.S. and Canadian border, spans nearly 300,000 square miles. Water that falls inside this basin is ultimately gathered by the St. Lawrence River that flows out to the North Atlantic.

These grand watersheds, of course, are not separated by a mountain range. In most places the divide, which runs about 1,500 miles
from eastern Minnesota to western New York, is a gently sloping hill. In some places it is merely an imperceptible bump in the landscape. And in Chicago it was, historically, nothing but a marshy area feeding two rivers flowing in opposite directions. The west side of the Chicago divide flowed into the Mississippi-bound Des Plaines River. Its eastern side flowed into the tiny Chicago River, which trickled into Lake Michigan.

Or at least that's how things used to work.

The first European explorers who came upon this sag in the divide in 1673 must have been shocked as they paddled their way back from an expedition down the Mississippi River. Father Jacques Marquette and Louis Joliet planned to return to their base near the northern tip of Lake Michigan along their outbound route, which required an arduous portage across the basin divide in what is now central Wisconsin, but the Native Americans they met on the return trip steered them to this shortcut at the southern end of Lake Michigan. Here the explorers only had to tug their canoes across a marshy area less than two miles wide. Marquette and Joliet knew immediately this soft spot in the divide was among the most strategic points on the continent: if it were someday breached with a canal, it could open a nonstop navigation corridor between Lake Erie and the Gulf of Mexico, and that meant opening the door for trade and supplies to fuel settlement of the middle of the continent.

It took almost two hundred years, but the Chicago divide was finally destroyed in the mid-1800s with a relatively crude navigation channel. This canal removed the last plug in a continental navigation network that finally allowed for goods and people to float up the Erie Canal from the East Coast, across the Great Lakes and then down the Mississippi River and into the Gulf of Mexico.

How important was this 6-foot-deep ditch to the development of Chicago? Its population was less than 5,000 in 1840, at the time the canal was under construction. Just over a decade after the canal opened in 1848, the city's population burst to more than 100,000, and it nearly tripled again in the following decade. Barges pulled by mule across the divide were laden with so much cargo—grain, lumber, livestock and foodstuffs like fruit, sugar, salt, molasses, and whiskey—that Chicago, once a swamp in the middle of the continent, had become the nation's busiest port by 1869.

The economic benefits of a canal that cost $6.5 million to construct were astounding, but the true cost of Chicago destroying its continental divide—the price paid for essentially re-plumbing half the continental United States—would not be known for another 150 years. As was the case with the St. Lawrence Seaway and the earlier canals linking the Great Lakes to the East Coast, opening this Great Lakes' "back door" to the waters of the Gulf of Mexico unleashed not only the intended stream of commerce. It also, eventually, let loose an unintended torrent of ecological trouble nobody pondered when the first shovel took the first scoop of earth out of the divide on July 4, 1836.

As in the great Greek myth, the problems started with a box. A box full of fish.

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**ON A BRISK NOVEMBER DAY IN 1963, A STATION WAGON PULLED** up to the brown brick federal research lab in eastern Arkansas loaded with a radical new weed killer. In the wake of the publication of Rachel Carson's *Silent Spring* the previous fall, there was an increasing awareness of the potential perils of all the herbicides and pesticides flowing in our rivers, across our croplands and orchards, down our grocery aisles, onto our dinner tables, into our bloodstreams. Poisoning rivers to get rid of nuisance fish was particularly in vogue at the time, including the Russian River in northern California and Utah's Green River, and a clamor was growing for a smarter, gentler approach to combating
unwanted creatures and vegetation. So researchers at the U.S. Department of Interior’s Fish Farming Experimental Laboratory, located in the heart of Arkansas catfish farming country, were taking delivery of what they hoped would be a new generation of nontoxic aquatic weed-control agents.

The station wagon’s tailgate was dropped and three cardboard boxes, each with two white arrows pointing up, were hauled through the lab doors. The label on the boxes from Malaysia told the handlers that this was not just another toxic chemical compound whipped up in a lab. It read: “Live Fish.” The boxes contained dozens of juvenile grass carp, a species native to Asia and famous for taking to forests of seaweed like locusts to crops. The idea at the research lab was to deploy these fish instead of chemicals across the South to clean fish farm ponds as well as weed-choked rivers and irrigation ditches.

“When they did this, this was right. This was the thing to do,” said Andrew Mitchell, a recently retired biologist from the federal research lab. “It was one fish to do one job—keep chemicals out of the environment.”

That station wagon’s payload was the first documented shipment to the United States of a group of fish collectively known as Asian carp. Within a decade of the grass carp’s arrival, an Arkansas fish farmer seeking his own batch of the exotic weed-eating fish accidentally imported the three other Asian carp species: black, bighead and silver carp. He didn’t know what to do with these other types of Asian carp because they weren’t weed-eating machines. Silver and bighead carp are filter feeders that strip plankton and other floating nutrients from the waters in which they swim. Black carp live off mollusks.

The fish farmer did what he thought was the right thing. He turned his exotic fish over to the government. State fishery workers could have destroyed these Adams and Eves. Instead they decided to try to get the novel brood to reproduce—just for kicks, apparently.

“We had this little agreement that if we learned how to spawn them, that he got some of the stock back,” former Arkansas Game and Fish Director Scott Henderson told me. “It was all cordial. We were interested in doing some research to see what they were, and I guess at the time, getting them out of the public.”

The fish farmer gave Henderson’s department 22 adult silver carp, 20 adult black carp and 18 adult bighead carp and, like cavemen trying to spark a fire, the state hatchery workers tried feverishly to get their brood of exotic fish to breed. They had little luck because, it turns out, raising Asian carp in hatcheries is an absurdly intricate procedure that requires precise timing and water conditions, as well as injections of crushed fish pituitary glands and human hormones harvested from the urine of pregnant women.

The hatchery workers killed all the black carp before they could reproduce a single fish, but they had better luck with the bighead and silver carp when they turned to S. Y. Lin, a professor at National Taiwan University who had moved to Washington, D.C., as an employee of the United Nations Food and Agriculture Organization. In his three weeks in Arkansas back in the early 1970s, Lin took two 12-pound silver carp and produced nearly one million eyelash-sized silver carp fry. The one 15-pound bighead carp Lin worked with produced 20,000 little bigheads.

And the Arkansas fish biologists had their fire.

Not long after they had cracked the breeding problem, the Arkansas Game and Fish Commission agreed to send some of their fish to other aquaculture research facilities, including Auburn University. They also entered into a contract with the U.S. Environmental Protection Agency to employ the curious carp in sewage treatment experiments. Former Arkansas Game and Fish chairman-turned-fish-farmer Mike Freeze explained to me the rationale behind the bizarre experiments while bouncing around in his pickup along the levees con-
taining his crops of catfish. Arkansas waterways in the 1970s, Freeze explained, were like waterways everywhere else in the country—ridiculously filthy, in part because small communities didn’t have adequate sewage treatment systems.

So Arkansas turned to the filter-feeding carp in an elegant, if a bit repugnant, plan to clean up its waters. Phase One was to plant bigheads and silvers in experimental sewage lagoons and let them convert the decaying human waste into fish flesh. Phase Two would be to sell those fish as food to fund small cities’ sewage treatment costs. The fish, particularly bighead carp, are favored in Asia for their flaky, mild flesh.

“I remember we sent sample after sample [of fish] from the sewage ponds to Baylor University to make sure they didn’t have any viruses or things like that,” said Freeze, who was an hourly worker at the state hatchery during the time of the carp experiments. It didn’t take long for word of Arkansas’ feces-to-flesh business plan to spread, and the federal Food and Drug Administration soon stepped in. “They had a standing policy,” said Freeze, “that it was not legal to take these fish out of sewage ponds and sell them for human consumption.”

The experiments stopped when federal funding dried up. Some fish were destroyed. Others were simply set free. Freeze remembers containment screens swinging open and gates being lifted to drain hatchery ponds—and their inhabitants—into Arkansas ditches and streams. It all seemed innocuous at the time—the fish were so difficult to breed under even precise hatchery conditions that nobody thought there was any chance that the carp would be able to breed on their own in the wild. This was a blunder of the highest order. Soon baby bighead and silver carp started turning up in rivers and streams across the South, and the swarming fish have been migrating north ever since.

The problem is bighead and silver carp don’t just invade ecosystems. They conquer them. They don’t gobble up their competition. They starve it out by stripping away the plankton upon which every other fish species directly or indirectly depends. Bighead carp can grow larger than 100 pounds and each day consume up to 20 pounds of plankton. Bighead and silver carp have so squeezed aside native species that the Asian carp biomass in some stretches of rivers in the Mississippi basin is thought to be more than 90 percent—the same dire situation that an alewife-plagued Lake Michigan suffered in the 1960s.

A fishing boat, brimming with bighead carp.

It’s not just native fish species that suffer where these fish succeed. Silver carp, which are slightly smaller than bighead carp, have become YouTube sensations because of their penchant for rocketing out of the water like piscine missiles when agitated by the whir of a boat motor. One such video starts with a Star Wars-style opening. Text scrolls in
front of a globe spinning in space, and an arcing red line shows the invasive fish's journey from Asia, across the Pacific Ocean to the Illinois River town of Peoria. What follows is some four minutes of young men water skiing while wielding swords and wearing football helmets bristling with giant nails. Fish-impaling spikes poke similarly from shin guards. One water skier protects his torso by wearing a bum-in-a-barrel-style metal garbage can. The water skiers swat, smack and hack at the hundreds of fish bursting from the water like popcorn.

All joking and ridiculously dangerous stunting aside, water skiing and jet boating have become impossible in some places, particularly on the Illinois River where things are so bad that the town of Bath hosts an annual “Redneck Fishing Tournament.” It is the one time of year in this southern Illinois hamlet you will find the river packed with motorboats. They are piloted by beer-swigging, helmet-wearing anglers who try to catch as many silver carp as possible in three hours—not with hooks and lines, but by waving fishing nets in the air.

The year I attended the tournament I saw several people leave the water after being battered and bloodied by the jumping fish that hit hard as a fist. I saw one man, not smart enough to wear a helmet, spit out a tooth. The tourney’s 78 registered boats that day landed 1,840 fish, all of which were buried with a backhoe on the riverbank. The bar owner who hosted the tournament assured me the mass grave didn’t even dent the population swarming in the river, but insisted that was not the point of the event. She hosts it to provide locals a bit of zany, late-summer fun and, more importantly, she said it serves as a warning to people across the country of what could be coming to their own lakes and rivers. She had a particular set of lakes in mind.

“If these things get into the Great Lakes,” she told me, “you are in trouble.”

The word trouble doesn’t really capture what is at stake, both environmentally and economically, if the oversized fish succeed in what has so far seemed like their inevitable push to colonize the Great Lakes, the biggest home they could ever hope to find, and one that still sustains a multibillion dollar commercial and recreational fishery.

While silver carp make the headlines for their leaping ability, bighead carp lurk largely out of the public’s consciousness. Not so for commercial fisherman Orion Briney, who more than a decade ago figured out how to eke out a living by catching bigheads on the Illinois River and selling them to a wholesaler who guts, ices and ships them by the refrigerated container-full back to China.

Briney can catch 15,000 pounds of bigheads in his nets. Not in one day. In 25 minutes. Here is a little perspective on that number: Wisconsin's quota for commercial perch fishing on all the state waters of Lake Michigan in some past years has been about 20,000 pounds. That's not a per-day limit. That's the limit for an entire year.

I went out one steamy summer day with Briney and was left gob-smacked (and silver carp—smacked) by what had become of the river since the invaders had swarmed in just a few years earlier. Briney fishes cowboy-style, using his boat to herd his quarry. “See that big wave?” he asked me as we roared downstream at dawn. I could see only a patch of choppy black water. “I'll bet there is 400,000 to 500,000 pounds in there!” He arced his boat toward the fish and then swooped down behind them, chasing the thrashing mass into his nets. Briney had no interest in the silver carp flying about the boat—and his head, which he deftly shielded with his Popeye-sized forearms. He was angling only for bigheads, a tastier and less bony fish that has a small market in the United States and, because bigheads are typically sold live in Asia, has only limited appeal abroad.

It took him less than a half hour to round up more than 13,000 pounds of fish—and another 3½ hours to pluck out the bigheads, one by one, from 800 yards of net. The biggest weighed nearly 40 pounds, monsters that lurked so low in the murky water they're rarely seen
by the pontoon boaters and recreational anglers that still dare to venture out on the river. Seeing one up close is unnerving. The fish have mouths big enough to gobble softballs whole and their eyes are so low on their head that they appear to swim upside down.

"Most people don't even know them's here," Briney said as he piled the writhing bigheads on the boat floor. "They just see the silvers jumping." Does he see the carp finding a future in the Great Lakes basin next door? "They'll thrive. There's plenty of food," he said. "They'll love it." Then he asked me: "The lakes are, what, 20, 30 feet deep?" No. The Great Lakes are hundreds of feet deep.

"Good Lord!" he groaned. "By the time [anyone] knew they had a problem, it'd be too late."

Biologists remain dubious about whether bigheads and silvers could thrive similarly in the Great Lakes' open waters, which are relatively sterile compared to the soupy rivers lacing the Mississippi basin. But it may be another matter altogether for the lakes' algae-rich bays and harbors, and the rivers that feed them—which also happen to be the places where most people boat, jet ski and fish. Inland waters connected to the lakes are similarly threatened. The financial impact of an infestation of these areas alone could be staggering. The eight Great Lakes states alone are home to some four million recreational boats, about a third of the United States' total.

Arkansas' Freeze knows these numbers and he has lamented from afar the bighead and silver carp's inexorable march north. He told me he believes that after his crew let their fish go free there were subsequent escapes of bighead and silver carp from research facilities and fish farms (captive-raised bighead carp eventually became a common cash crop for fish farmers, though it is now illegal to transport them live across state lines.) He also provided me documentation showing that the federal government later helped fish farmers reimport black carp to control pesky snails in aquaculture ponds. Not surprisingly, black carp are now also swimming free in rivers down South.

But he acknowledges that the bighead and silver carp that got loose on his watch almost surely were among the first to get into the wild. He's not proud about his role in what is shaping up as a billion-dollar blunder. But he doesn't hide from it, either. "I'm old enough and big enough," he said, "to say that there are a lot of things in my life that I'd go back and change."

Had Chicago just stuck with its first continental divide-busting canal, the carp could probably have been blocked from entering the Great Lakes with little more than a caravan of dump trucks loaded with sand and gravel. But, as was the case with the earlier canals that opened the Great Lakes to the Atlantic Coast, big enough was never big enough for long.

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IN THE OPENING STANZA OF HIS 1916 ODE TO CHICAGO, POET CARL Sandburg playfully refers to his City of the Big Shoulders as Hog Butcher for the World and Player with Railroads. He might also have added Conveyor of Crap, because less than two decades earlier Chicago built what is essentially a continental-sized commode, turning Lake Michigan into the world's largest toilet tank, and the Gulf of Mexico into its toilet bowl. It was a matter of life and death for a mushrooming city that sent its sewage into Lake Michigan, from which it also takes its drinking water.

In the 1890s, in order to protect that drinking water, engineers began work on the Chicago Sanitary and Ship Canal. The city's motives for the canal are made clear in its name; when it opened in 1900, its primary job was to flush the city's waste across the continental divide and into the Mississippi River basin. It also, conveniently, doubled as a
massive expansion of the original barge canal linking Lake Michigan to the Gulf of Mexico.

The rail-straight, 25-foot-deep canal that is as wide as a football field does a most remarkable thing. It reverses the flow of Chicago’s namesake river, which was in its natural state a shallow, slow-flowing dribble feeding Lake Michigan. Its headwaters were just several miles west of downtown at the bog Marquette and Joliet first came across in the late 1600s. The Sanitary and Ship Canal, which is lower than Lake Michigan, connects to this river. This pulls the formerly lake-bound river’s flow backwards. Instead of the river feeding Lake Michigan, the lake now feeds the river. The river then flows into the canal, the canal flows through the continental divide and into the Des Plaines River, which flows into the Illinois River, which flows into the Gulf-bound Mississippi River.

The canal did exactly what Chicagoans hoped: it preserved the source of their drinking water. It also brought immense controversy in Mississippi River-drinking cities like St. Louis, which did not relish the notion of consuming Chicago’s sewage, even if it was diluted by the 357-mile trip down from Chicago.

In early January 1900, just as its construction neared completion, the state of Missouri petitioned the U.S. Supreme Court to block opening the canal’s connection to the Des Plaines River. That prompted Chicago leaders to sneak out of town on a train in the early hours of January 17 to open the downstream canal gates before the court could stop them. There was little pomp in a ceremony the New York Times characterized as one conducted with “undignified haste,” at the conclusion of which a pale green tongue of Lake Michigan water crashed into the Mississippi basin. Chicago’s raw sewage wasn’t far behind, and it didn’t take long for the fouled downtown stretch of river to be flushed of its accumulated excrement—a city-sized enema. “Water in the Chicago River Now Resembles Liquid,” a Times headline deadpanned in the days after Lake Michigan water first entered the upper portion of the canal. The Mississippi River basin and the Great Lakes have been unnaturally connected by a canal wider than a Los Angeles highway ever since.

In making its case to the Supreme Court, Missouri reported that the annual number of typhoid fever cases in St. Louis had approximately doubled in the four years after the canal opened, compared with
the prior four years. Even so, Missouri had a hard time convincing the justices of the Supreme Court that Chicago toilets were the problem. It was the dawn of the 20th century, and the science of microbiology was in its infancy. The plaintiffs contended that the typhoid bacillus could survive the 8 to 18 days it took for Lake Michigan water to flow to St. Louis. The defense argued it could not. And the justices were left dubious about the danger posed by an invisible menace.

“There is nothing which can be detected by the unassisted senses—no visible increase of filth, no new smell,” Justice Oliver Wendell Holmes Jr. wrote in the court’s majority opinion, finally rendered in 1906. “On the contrary, it is proved that the great volume of pure water from Lake Michigan which is mixed with the sewage at the start, has improved the Illinois river in these respects to a noticeable extent. Formerly it was sluggish and ill smelling. Now it is a comparatively clear stream.”

Today it is clear that dangerous—even deadly—microbes can lurk in the purest-looking glass of water. But more than 100 years ago it was a different story. “The plaintiff’s case depends on an inference of the unseen,” Holmes concluded. This would not be the last time the federal government turned a blind eye to invisible trouble lurking in the canal.

St. Louis’s typhoid fever troubles evaporated with advances in water treatment in subsequent decades, and Illinois’ Great Lakes neighbors long ago learned to live with a slightly diminished Lake Michigan because the canal was built to siphon away up to six billion gallons of lake water per day (the subject of another Supreme Court case filed by Wisconsin in the 1920s that also failed to end Chicago’s Great Lakes water grab). But by the late 20th century, the larger, unforeseen costs of tinkering with the hydrology of a continent were coming into focus, and they had nothing to do with water levels on Lake Michigan or downstream cases of diarrhea. It became apparent that Chicago had accidentally built a superhighway for Great Lakes invasive species to fan out across North America.

As we’ve seen, ships sailing up the St. Lawrence Seaway have dumped dozens of exotic critters into the Great Lakes since it opened more than a half century ago. The Chicago canal system turned this regional problem into an ever-growing national one as invasive species ride its waters out of the Great Lakes and into the basin that connects the waters of 31 states.

Scientists have identified 39 invasive species poised to ride the Chicago canal into or out of the Great Lakes, including a fish-killing virus in Lake Michigan today that could ravage the South’s catfish farming industry as well as five species of nuisance fish, including the sea lamprey. Threatening from the other direction, beyond the Asian carp, is the razor-toothed snakehead, which can breathe air and slither short distances over land and is now swimming loose in the Mississippi basin.

This problem was recognized nearly two decades ago, when Congress, alerted to the idea that Great Lakes invaders were primed to make their way out of the lakes and into the Mississippi basin, authorized construction of an experimental electrical barrier on the canal, about 35 miles downstream from Chicago’s Lake Michigan shoreline.

Underwater electric barriers to block migrating fish had been successful on streams and irrigation canals in the West, but never on a waterway as big as Chicago’s, and never on one that is a major navigation corridor plied by thousands of barges annually. After six years of designing, building and debugging, the Army Corps finally turned on the $1.5 million contraption in 2002. But by then the species of Great Lakes invasive fish that scientists had feared would use the canal to escape into the Mississippi basin had already done so. So the barrier was repurposed as a device to halt the migration of Asian carp into the lakes from the other direction.

The barrier was always intended to be just a Band-Aid until a more permanent solution could be devised. But soon after it was activated, Congress became convinced it was worth funding a giant version,
one built to last decades and operate at four times the strength of the original. Construction started in 2004 and was finished in 2006. But then the government refused to turn it on, largely because of the U.S. Coast Guard’s fear that its electrical current would cause sparks to fly between canal barges, some of which carry petroleum and other flammable materials. The Coast Guard’s primary mission, after all, is to protect the barge workers and recreational boaters floating up and down the canal. It’s not to worry about what type of fish are swimming in the Great Lakes, even if it’s a type of fish that some fret could utterly upend the world’s largest freshwater system. As the former chairman of the commission that helps guide U.S. and Canadian management of the Great Lakes has put it: if the fight to stop the giant fish from colonizing the lakes fails, well, “it is just a matter of time before we end up with a carp pond.”

BARRIER SAFETY TESTS DRAGGED ON INTO EARLY 2008 WHEN

Army Corps General John Peabody arrived to take charge of the carp fight. Peabody is a 1980 graduate of West Point who has done tours in the Pacific, Panama, Somalia and the Middle East, where he led 3,000 engineers into Iraq during the 2003 attack on Baghdad. In his three-plus decades in uniform, Peabody has picked up a graduate degree in public administration from Harvard, studied as an Olmsted Scholar in Mexico City and earned his master parachutist badge. He has received a Bronze Star for valor as well as a Purple Heart. The general limps on a metal hip. He has a penchant for quoting war movie dialogue and commands most any room he walks into with a no-nonsense demeanor that borders on brusque.

But he was also once a little boy who relished hot summer days at Lake Erie’s Nickel Plate Park beach in Huron, Ohio. “The night before, we’d get picnic baskets, beach balls, all the rest, in our station wagon—

this was the ’60s . . . and my brothers and I would get all excited: ‘Daddy, Daddy! Mommy’s taking us to the lake!’” the general told me, as he knocked back a late-afternoon coffee at the massive conference table in his office in downtown Vicksburg, Mississippi. “And my cynical dad would say: ‘Your mother is taking you to the biggest cesspool in northern Ohio.’”

Despite the stench of all the rotting alewife carcasses littering the polluted beach when he was a child—one of which Peabody vividly recalls gouging his foot—the Great Lakes stole a soft spot in the heart of the hard-nosed general that motivated him when he took over the carp fight. “There was an opportunity for us to prevent a really bad thing from happening—a calamity, a crisis, whatever word you want to put to that.”

In the months after he took over the job, Peabody turned on the new electric barrier that the Coast Guard had kept mothballed. As a safety compromise with his sister agency, Peabody ordered the new barrier, which was designed to run as high as four volts per inch, to run only at the same voltage as the nearby demonstration barrier: one volt per inch. One volt does not provide a strong enough jolt to stop juvenile fish, which, because of their size, are more immune to electrical pulses. But one volt was a level the barge industry could live with and, at the time, no Asian carp had been detected near the barrier.

“If the fish weren’t close enough to be a threat, it didn’t seem prudent at that time to raise the operating parameters,” Peabody told me. That was a big if, and the general knew it. Biologists tracking the pace of the Asian carp’s migration up the Mississippi and Illinois Rivers believed that by 2008 the fish should have long ago been probing the barrier, even though crews using nets and electroshocking devices continued to turn up zero evidence of fish in the area. Everyone involved knew that finding the first few fish at the leading edge of the invasion
would be exceedingly difficult because the fish have an uncanny ability to avoid nets. Shocking the water to stun the fish so they float to the surface doesn’t work either, because Asian carp can often lurk too deep to be stunned.

Even though the nets used to hunt the carp near the barrier came up empty, Peabody still smelled trouble in the canal. “Our lack of information was so great,” he told me. “I felt we had to take whatever we could and apply it as quickly as possible to try and get more information.”

The University of Notre Dame’s David Lodge had what he was looking for.

Lodge is one of the country’s leading invasive species experts with a reputation as a scientist who isn’t content to see his work go dusty on library shelves. The bespectacled 60-something with a younger man’s shock of black hair still has a bit of a Southern drawl from his boyhood in Alabama, yet he enunciates his words in such a precise manner it is easy to picture him as the budding naturalist he remembers being as a child.

“I was one of those kids who just was fascinated with nature from the get-go,” Lodge told in an interview in his office at Notre Dame’s “Innovation Park,” a gleaming new building where fingerprint scans open locked doors. “I spent all my idle moments turning over rocks in streams and swimming, snorkeling, fishing, catching frogs and snakes and turtles and whatever else I could catch...I spent my free time inside reading field guides. That’s not your average teenage activity. But I was more happy doing that than playing baseball.”

Lodge thought about studying history when he got to college, “But in the end I think it was pretty clear to others, even if it wasn’t always clear to me, that I just loved biology.” That love carried him to Oxford University as a Rhodes Scholar. He went on to serve as chairman of President Bill Clinton’s Invasive Species Advisory Council and to create Notre Dame’s Environmental Change Initiative, a team of university researchers that aims to inform public policy decisions on hot-button environmental issues such as invasive species and climate change. Crossing the line from pure academic research into public policy wasn’t something he did lightly because at the beginning of his career it wasn’t even considered acceptable.

“When you wrote proposals to get research to support your work, you didn’t couch them in terms of what problems you were going to solve in the world,” he said. “You couched them in terms of intellectual excitement and new ideas.” But that line has blurred in recent years, and today Lodge’s work is often at the center of some of the Great Lakes region’s prickliest ecological and political debates. He’s done research to predict which species are most likely to invade the Great Lakes if ships are allowed to continue discharging contaminated ballast water; he’s helped put a price tag on the annual cost of invasive species to the Great Lakes (an estimated $200 million); he’s done work predicting which freshwater fish species are most likely to go extinct because of climate change.

Straddling the worlds of politics and science has never been a comfortable exercise for Lodge. Messengers, after all, sometimes get vilified for delivering grim news. But Lodge came to figure the stress of publicly defending his work in the media and to policy-makers was the price for doing science that mattered. By summer 2009, with Asian carp migrating toward the Great Lakes and federal officials desperate to find someone who could show them exactly how far the fish had advanced toward Lake Michigan, that price was about to explode.

Lodge’s skills as an ecologist and his willingness to wade into sticky issues had made him and his colleagues a logical choice a few years earlier when a think tank funded by the Great Lakes states gave his lab a grant to develop a genetic-based test to identify invasive species hitchhiking into the lakes in the ballast water of Seaway freighters. Law enforcement investigators have been using DNA analysis for
more than two decades to put criminals behind bars. These genetic fingerprints can be harvested from almost anything the human body sheds—flecks of skin, strings of saliva, drops of semen, strands of hair. From that material, scientists can isolate and identify the molecules that are an individual’s DNA, the famous double helix. Each minuscule twisting ladder is made up of billions of rungs built from four types of chemicals, called nucleotides. DNA is such a powerful forensic tool because the order of these billions of rungs, each made up of two interlocking nucleotides, is unique for each individual. Scientists zero in on relatively short sequences of nucleotides on a piece of human DNA to see if the genetic material harvested from a crime scene is a match for DNA taken from a suspect.

But this genetic fingerprinting process also works on the species level; all silver carp, for example, share an identical sequence of nucleotides at various places in their DNA. It wasn’t a big leap for the Notre Dame team to realize that DNA testing could be used to find evidence of carp in the canal. This kind of analysis had already been done on a smaller scale by an Italian researcher who used traces of DNA to find American bullfrogs in European ponds. It works because fish and other aquatic life constantly shed cells in mucus, urine and feces. Those cells tend to stay suspended in water, and that means every fish leaves in its wake a genetic trail. That trail can be traced by filtering all the DNA from all the different species that have left behind a piece of themselves in a water sample.

Once that pile of DNA is isolated, lab technicians put it in a test tube and add to it some precisely engineered genetic markers—called primers—that are designed to attach only to the DNA of the targeted species. A concoction with free-floating nucleotides is also added to the mix and then the sample is heated. The heat unravels the DNA helixes of all the species filtered from the original water sample. If any of the targeted species’ DNA is present, the primers glom on to each separated helix as the sample cools. That starts a zipper-like reaction in which an enzyme that is added to the sample binds the free-floating nucleotides to each strand of original DNA. Suddenly one piece of DNA has been turned into two. The process is repeated over and over so that even a single piece of DNA can be replicated beyond a billion, to the point the target DNA can actually be seen as a glow under ultraviolet light when yet another chemical is added. One piece of DNA wouldn’t be enough to identify a species in a sample, nor would 100,000. But once you get a billion or beyond, a visible glow emerges.

Now a previously invisible fish is revealed.

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IT ALL WORKED BEAUTIFULLY IN THE NOTRE DAME LAB, BUT Lodge’s team knew there was a big difference between isolating DNA floating in aquariums and sifting it from a free-flowing river. By early 2009, Lodge’s staff was ready to try. At a January meeting in downtown Chicago among researchers guiding operation of the Army Corps’ electric fish barrier, one of Lodge’s assistants pulled an Army Corps biologist into a quiet corner. He told her he believed they had cracked the problem of filtering and identifying Asian carp DNA from open water and he thought it could be applied on the Chicago canal. The biologist took the idea to her bosses at the Army Corps’ regional office in Chicago and got the go-ahead. At that time, Peabody had no idea what his staff or the Notre Dame scientists were up to.

Andy Mahon, an ecologist and geneticist who worked in Lodge’s lab back then, remembers the miserable morning a few months later when he and a colleague gave their new fish-hunting tool a whirl on the muddy, spring-swollen Illinois River. They figured if DNA didn’t turn up in a place like this, known to be thick with Asian carp, there was no sense trying to detect it where there might be only a handful
of the fish. The two spent the morning freezing their hands filling two-liter plastic bottles, the excitement they had felt just weeks earlier in the lab tumbling away as they worked. How could they possibly find mere molecules of fish in all this murky water? Mahon headed back to South Bend with his spirit as chilled as the bones in his fingers. He was alone in his lab testing the samples a few days later when the telltale glow emerged. He dashed down the hallway looking for Lodge and the others.

“Shocked,” is how he described their collective reaction.

The team decided to move the testing slowly up the river, toward areas where carp numbers were known to be lower. “We had developed the tool and tested it the best way we could—in the lab, and in the field in a preliminary way,” Lodge said. “But to build our own confidence and build the confidence of anybody else, we wanted to start in places where everybody agreed there were fish. So the general strategy was to start south and work our way north [toward the barrier], because the whole idea was to identify where the leading edge of the invasion front was.”

When Peabody finally got word of what the Notre Dame scientists were up to, he requested a face-to-face meeting. In the summer of 2009, the general and his staff showed up at Rosie’s Family Restaurant just down the road from the electric fish barrier in an industrial corner of suburban southwest Chicago. Peabody and his staff, as usual, arrived in combat dress—camouflaged pants tucked into high-laced boots—to grill one of Lodge’s colleagues on what the Notre Dame team was trying to do.

Peabody planted himself at the head of a table with the Notre Dame scientist at his side (Lodge was not there that day; he had a class to teach). The general’s staff scattered around, some standing, some sitting at the table. A map was unfolded. Sugar packets were used to represent fish, barriers and boats. It was at times an awkward summit between military men who were demanding clear, yes-or-no answers and a scientist who makes his living in the fuzzy place at the edge of human knowledge.

Lodge’s crew knew it was wading into murky waters. For one thing, the specific technique it developed to hunt for Asian carp in rivers hadn’t at that point been published in a scientific journal, which meant it had not been independently validated by other scientists. What’s more, this type of DNA analysis can indicate nothing about numbers of fish, their precise location (DNA drifts on the current), exactly how long that genetic material has been in the river or even how it might have gotten there. But Peabody was determined to find out if the fish were pressing up against the new barrier. If the general could demonstrate that the giant carp (or even their tiny offspring) had indeed arrived at the barrier, that could justify cranking up its voltage. Peabody heard enough that day to be convinced DNA was the best tool he had to find the fish. He allowed Lodge’s team to press on.

The Notre Dame team continued northward in its testing—and continued to turn up evidence of the fish. In September 2009, it reported Asian carp DNA about 10 miles farther upriver than the fish had ever been seen. If the DNA evidence was correct, Asian carp had passed through the last navigation lock before the electric barrier. A lock is a relatively tricky obstacle for a group of fish trying to colonize new waters because a fish has to accompany a boat into the lock chamber and exit with it once the boat is lifted and the lock gates are opened. Think of a cockroach using an elevator to migrate between floors of an office building. It probably will happen eventually, but it involves a certain amount of luck. Then, to establish a breeding population, others have to make the same trip. Then they have to find each other.

The general might not have been pleased with fresh intelligence that at least one fish had apparently breached the last lock before the electric barrier. But at least this new DNA tool seemed to work precisely
the way he had hoped. Like a pair of night-vision goggles, it illuminated a previously invisible enemy, and that gave the general a chance to fight back. Peabody doubled the barrier voltage.

The Notre Dame team pressed on with its sampling. Lodge didn’t plan to stop until he got to an area of the river where all sampling showed no trace of DNA. “The whole point,” he said, “is to go to where we got all zeros, and of course, everybody, including us, was hoping all zeros happened below the barrier.”

Everything changed on November 18, 2009, at 7:48 a.m. That’s when Lodge sent an email notifying Army Corps officials that water samples beyond the barrier had tested positive for Asian carp. This was not a memo Lodge wanted to write. When it was time to hit the send button, he said, “It made me feel a little sick.”

Lodge reckoned a positive sample above the barrier meant at least some Asian carp had somehow gotten through. Like everything else, DNA can’t drift upstream. Environmental groups and politicians from neighboring Great Lakes states pounced at the news that the Great Lakes’ last line of defense against an Asian carp invasion had apparently failed. They demanded that the Army Corps stop operating two navigation locks near downtown Chicago. The idea was to use the locks as makeshift dams to block the carp’s final advance into Lake Michigan. The problem is that closing the gates would not just stop fish, it would also stop the free flow of cargo on the canal, a move that Illinois barge operators said would have disastrous consequences not only for their businesses but for the industries they serve, as well as the fleet of recreational and tour boats in downtown Chicago. But just as it is dubious that closing the St. Lawrence Seaway to overseas traffic would have devastating international economic consequences, the financial impact of shutting the locks (which would affect less than one percent of the total cargo moved through the Chicago region daily) was probably overblown by the barge industry.

Even so, Peabody, who is in the business of moving barges, wasn’t about to recommend lock closure, which he argued wouldn’t necessarily work because the structures are aged and leaky and the fish might pass through in any event. The locks would also have to be opened if big rains hit because when the water level gets exceptionally high in the Chicago canal, the whole system reverses and the Chicago River temporarily flows backwards into Lake Michigan. Not opening the locks to allow this to happen could inundate downtown Chicago.

In any case, Peabody clearly felt he was already doing enough. He’d cranked up the voltage at the barrier and, just days before he learned that Asian carp DNA had been found beyond it, his agency backed a most radical plan to literally stop dead any migrating fish.

ON THE GRAY MORNING OF DECEMBER 3, 2009, THE CHICAGO SANITARY and Ship Canal looked like a crime scene. Yellow police tape laced the banks. Roads to the water’s edge were blocked by police officers shivering in the cold, unable to explain to passersby precisely what had happened. Behind the barricades, a generator thrummed outside a huge government tent with computer workstations and coffee for the 400 federal, state and Canadian fishery workers who had descended on this industrial corner of Chicago from as far away as Quebec. Just outside the tent, the bosses of the operation corralled the cluster of news reporters at the water’s edge to tell their story. They were the ones who had killed the canal, they explained. They had poisoned it because they were at war—with Asian carp.

The first hint that the river was dying came when the fish started to float to the surface, their white bellies aglow in the lifting dawn light. One by one they popped into view, the way stars emerge at dusk. Some could only flap their gills as they drifted on the tea-colored current. Others thrashed. All of them—ultimately a constellation of
ultimately the poisoning of the canal would yield about 54,000 pounds of flesh—there was not even one Asian carp.

Finally, at 7 p.m., Rogner again summoned reporters to the canal’s edge. They had found what they were looking for—a single, 22-inch bighead carp. Although it was unsettling news for the Great Lakes that the Asian carp—or an Asian carp—had indeed arrived in the waters just below the barrier, a wave of relief washed over Lodge as word reached the Notre Dame team. The sight of that one fish, he thought, at least validated DNA as a fish-hunting tool. Not everyone was so convinced.

Less than two weeks after the poisoning, a team of federal scientists arrived in South Bend to inspect Lodge’s lab. They scrutinized how water samples were stored, how they were filtered and what steps were taken to ensure Asian carp DNA hadn’t somehow contaminated any of the equipment, which could result in false positive results. The Notre Dame team felt a bit like its spouse had hired a private investigator to catch it cheating. The investigators found no such evidence. In fact, they came away impressed, writing in their official report that Lodge’s process is “sufficiently reliable and robust in reporting a pattern of detection that should be considered actionable in a management context.”

The Notre Dame team took that to mean that if you’ve got DNA, you’ve got strong evidence that the fish are there, and you could justify taking action to somehow plug the canal and block others from making the same trip. Still, Peabody wasn’t ready to believe that a positive DNA sample in the canal on the lake side of the barrier meant the fish were swimming free into Lake Michigan. The general worried the DNA might have gotten there some other way. Perhaps a barge coming up from the Asian carp-infested waters of the Mississippi basin had somehow picked up Asian carp slime or excrement on its hull. Or maybe the DNA came from the droppings of a migrating bird that had eaten an Asian carp on its way toward Lake Michigan. Or, perhaps, an
Asian carp flopped onto the deck of a barge below the barrier, and then flopped off it once the barge passed through.

Peabody knew he was taking a chance adopting a novel, untested technology in a high-stakes fight, but he felt compelled to find out where the fish were so he could make the smartest decision possible about how high to operate the barrier voltage. That was all he wanted from Lodge’s DNA sampling. He never expected DNA to surface beyond the barrier, but he was taken aback by the fuss it caused when it did.

“We got a few hits above the barrier,” he told me, “and some people were flat-panicked by that.”

But it wasn’t just “some people.” It was the attorneys general from five Great Lakes states who went to federal court in early 2010 to force the Army Corps and the State of Illinois to shut the navigation locks as a last-ditch effort to halt the advance. In just a matter of weeks, the decade-old saga of a giant, leaping type of carp slowly migrating north toward the Great Lakes had gone from a regional news story framed as a quirky situation on a curious river to national news about how two species of carp were tearing apart a region.

“Everybody got into this expecting we wouldn’t have any positive samples above the barrier,” said Lindsay Chadderton, an invasive species expert from the Nature Conservancy who helped the Lodge team develop and deploy the DNA testing. “The reality is if we had only found positives below the electric barrier . . . none of this controversy would have happened. The minute we started finding positives above the barrier, that is when the blame game started. That is when the litigation started with the lock closure, and that is when things started to get testy.”

The controversy over how much weight should be put on mere molecules floating in water became A-section news in media outlets as far away and as big as the New York Times, which reported that the fight to beat back the fish had so consumed President Obama’s Chief of Staff, Rahm Emanuel, that when he returned to Chicago in 2010 to run for mayor, Emanuel’s own staff sent him off with a dead Asian carp.

MOST BIOLOGISTS ACKNOWLEDGE THAT A SMALL NUMBER OF fish advancing beyond the barrier does not mean a self-sustaining Asian carp population in the Great Lakes has arrived, or that one is inevitable. For an invasion to be successful, first the fish have to be sexually mature, then they have to find appropriate spawning areas, then they have to find each other, and then their offspring have to figure out how to survive to adulthood in a new environment and find their own mates. Then the next generation has to have similar success. And so on.

For Peabody, this meant it wasn’t time to retreat and move the fight to the locks near Lake Michigan shoreline; it was time to stand his ground at the electric barrier. Meanwhile, Lodge’s team continued testing the waters beyond the barrier throughout the spring of 2010, and kept getting more positive DNA hits. Yet fishing expeditions with nets and electroshockers in the same areas continued to turn up zero Asian carp. Desperate to find an actual fish above the barrier and not just its genetic fingerprints, in late May 2010, six months after the first poisoning, the federal government and state of Illinois conducted a second river poisoning just six miles from the Lake Michigan shoreline in an area of water above the barrier that had repeatedly tested positive for Asian carp DNA.

This poisoning claimed another 100,000 pounds of fish representing some 40 species. Not one Asian carp was found. Peabody and the rest of the federal team in the carp fight walked away after the second poisoning more confident that the barrier was holding back the fish, and less confident that Lodge’s DNA samples meant fish were in the area.
Peabody and his colleagues with the U.S. Fish and Wildlife Service wanted an actual fish—and not just a lab report—before they would be convinced an actual invasion above the barrier was under way. This is harder than you might expect. Duane Chapman, a United States Geological Survey biologist, once marshaled four boats to chase three radio-tagged Asian carp for two days on a Missouri River tributary using electroshocking gear and commercial fishing nets. The radio tags emitted a signal that told the crew the precise location of the fish, which had been trapped between a set of two nets stretching the entire width and depth of the river. But the water was too deep for the electroshockers to force the fish to surface, and the carp proved cagey enough to avoid getting snarled in the nets.

“They know what nets are,” Chapman said, “and they avoid them.”

Finally, on June 23, 2010, a month after the second river poisoning and about a year after the Army Corps first hired Notre Dame to help it find the leading edge of the invasion, the Illinois Department of Natural Resources announced that a 20-pound adult bighead carp had indeed been caught in a fishing net beyond the barrier—just six miles from the Lake Michigan shoreline. “We set out on a fact-finding mission and we have found what we were looking for,” Rogner of the U.S. Fish and Wildlife Service proclaimed in a news release.

Lodge again felt a grim sort of vindication and Illinois’ neighboring states clamored louder for lock closure, arguing that the fish was, finally, irrefutable evidence the electric barrier was leaking Asian carp. Then a few weeks later Rogner issued another news release that claimed the fish might have been lifted around the barrier by human hands after a lab analysis showed that apparently it had spent at least some of its life in waters below the barrier. He based this theory on a lab analysis of the carp’s ear bones, which can sometimes tell researchers where a fish once lived, because different water bodies leave different chemical signatures on the bone. But not in this case—an independent reviewer of the lab analysis warned that no definitive conclusion could be reached about this particular bighead carp’s life history. Even so, the news release claimed that the bone analysis “does suggest to us that the fish . . . may have been put there by humans, perhaps as a ritual cultural release or through bait bucket transfer.”

The problem, beyond the peer reviewer’s caution not to use this fish’s ear bones to infer anything about its life history, is that an ear bone doesn’t contain any information about how a fish moves from one water body to another; it can’t reveal if a fish traveled in a tank in the back of a pickup truck or if it made the migration on its own. As for the story about a human planting it, bighead carp were at one time sold live in fish markets around Chicago, and rumors of “cultural releases” of Asian carp by people of Asian ancestry practicing some sort of ritual have swirled around Chicago for years. But when I pressed an Illinois Department of Natural Resources spokesman for any evidence of this actually happening with bighead or silver carp in Chicago, the best he could muster was a link to a Wikipedia article. It stated that animal releases were a common practice during the Ming Dynasty in China.

He didn’t offer to send me the Wikipedia article that mentioned the Ming Dynasty ended in 1644.

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PEABODY AND LODGE EVENTUALLY STOPPED COMMUNICATING and the two ended up in a downtown Chicago federal courtroom in early September 2010. They were both called as witnesses in the federal lawsuit brought by the neighboring states. In addition to lock closures, the states sued to force the Army Corps to expedite a congressionally ordered study of what it will take to permanently reconstruct the natural barrier between the Great Lakes and the Mississippi basin that the Chicago canal destroyed. When Peabody took the stand, he looked mildly agitated. “Never in my worst nightmares or wildest imagina-
tion did I think that a fish would so dominate my time and attention, because you don’t think of the Corps of Engineers doing that,” he told me later. “You think of us as managing water resource infrastructure and building things and fighting floods and doing that kind of stuff.”

During his day in court, Peabody talked about his doubts that positive DNA samples meant the presence of live fish, and he had a fish expert ally in the courtroom in Charlie Wooley, the deputy regional director of the U.S. Fish and Wildlife Service. Wooley testified that the federal government and state of Illinois had gone to extraordinary lengths to try to follow up on the positive DNA samples with evidence of actual fish. They hunted for the fish with nets, electroshockers and barrels of poison. And all they had to show for it was that single bighead carp above the barrier, and a single bighead carp in the waters just below the barrier—the fish killed in the December 2009 poisoning.

“The traditional methods allow us to go out and sample large areas very effectively, very efficiently in a relatively short period of time,” Wooley testified. “They are tried and true.”

Lodge countered on the witness stand that those traditional fish sampling tools are effective at capturing only 1 percent of a fish population on a river the size of the Chicago canal. That means if small numbers of Asian carp lurked among tens of thousands of fish, odds are they would never turn up in a net or float to the surface if shocked. Asian carp, unlike many other fish species, also have a tendency to sink when poisoned. All this, Lodge has long argued, is precisely what makes DNA surveillance so powerful. But it’s only as powerful as the trust you put in it.

“Continuing to try to use the traditional tools to detect the presence of rare or of very sparse populations is like saying: ‘You know, even though we’ve got an MRI machine, I’m going to try and detect your cancer with a physical exam; I don’t really understand what this MRI machine is doing, so I’m not going to believe it. I’m going to poke you with my fingers and figure out whether you’ve got cancer or not,’” he said in later interview.

Lodge was shaking as he ate from a bag of M&M’s after his testimony. He looked as if he had been the one on trial. The judge sided with the Army Corps and refused to issue an emergency order to shut the locks.

In early 2014, the Army Corps finally released a 10,000-page plan to permanently plug the canal to re-separate the two watersheds, a project that would require extensive sewage treatment upgrades because much of Chicago’s treated waste would once again flow into Lake Michigan. The agency said the project, which would include a transfer station to move barge cargo over the barrier, would take decades to construct and cost as much as $18 billion—a schedule and price tag critics contend is wildly overblown. An engineering study funded by a group representing the Great Lakes region’s mayors and governors, in fact, concluded it could be done for as little as $4.25 billion and a barrier could be in place in a matter of years, not decades.

The project remained on hold as of 2016, and its opponents are confident it never will happen. “I’ve been lobbying 25 years on behalf of industry,” said Mark Biel, the executive director of the Chemical Industry Council of Illinois. “I’m pretty good at killing bills and ideas that people come up with, and this one has all the elements you’d need.” Biel then listed those elements: the time it would take to accomplish; and the cost; the legal, regulatory and political hurdles tied to sending at least some of Chicago’s treated wastewater back into Lake Michigan.

“This is not going to happen in my lifetime,” the 51-year-old said. “And I don’t plan on dying anytime soon.”

Peter Annin, a former Newsweek correspondent and author who also previously worked with Lodge at Notre Dame, takes a longer view. He expects pressure to patch the breach between the basins will surge
possible with the voltage the barrier is operating at, but nobody before had ever bothered to drop a sonar-like camera in the water to see what might actually be in the canal.

The Army Corps brass remain nonplussed.

"Those aren't carp," Peabody's replacement, Brigadier General Margaret Burcham, told me in early 2014 in a conference room overlooking the downtown Chicago River—the very stretch of river that the migrating carp would pass through on their way into Lake Michigan, a mile upstream. Burcham isn't a fish expert; she has a graduate degree in computer science. Actual fishery experts weren't nearly as confident in what Burcham claimed to see—or, more specifically, claimed to not see.

"You can identify that they are fish. You can identify that they're moving—you can see that," Aaron Woldt, Fish and Wildlife's deputy assistant regional director for fisheries, told me. "But you can't tell [which] species."

The day an Army Corps general becomes convinced that an Asian carp invasion of the Great Lakes is under way—the day the fish regularly start turning up in nets above the electric barrier—is also a day it will probably be too late to do anything about it.

A tiny private fish pond in Missouri offers a distressing glimpse of what might be in store for the Great Lakes. The owner had stocked his personal fishing hole with catfish, bass and bluegills. He was pumping it full of fish food, yet the fish appeared to be starving. So in early 2010 he called in a pond consultant.

"They came out with electrofishing gear, caught some fish and looked at them," the Geological Survey's Chapman said. "The fish were emaciated and he didn't know why. He said, 'There's something wrong here. We need to start over again.' They brought in rotenone and completely killed the pond."

Over the next week, the rotting carcasses of about 300 bighead carp
surfaced. The smallest were 20 pounds. The big ones were a border collie–sized 35 pounds. “They looked like submarines coming out of the water,” said Chapman, who arrived on the scene in time to watch the last of the dead specimens surfacing. “They’d breach!”

Poisoned Asian carp, Chapman explained, are different from many fish species in that they typically don’t float to the surface unless the water is warm enough for gases to build up in their bellies, a process that can take a week. Or it may never happen if the poisoning occurs in cold weather, as was the case during the December 2009 Chicago canal poisoning.

It turned out, Chapman explained, that a decade earlier the previous property owner had stocked the tiny pond with a colony of bighead carp, one that eventually flourished right under the nose of the new owner, who had smelled trouble—but couldn’t see a thing.

Chapter 6
CONQUERING A CONTINENT
THE MUSSEL INFESTATION
OF THE WEST

The St. Lawrence Seaway invasive species problem is not just contained to the shores of the Great Lakes. The problem is as big as North America itself. “The Great Lakes are just a beachhead for invasions that are going to play out across the country in the next century,” says University of Wisconsin ecologist Jake Vander Zanden. “It’s just the start.”

And the biggest reason why is the Great Lakes’ back door: the Chicago Sanitary and Ship Canal.

The story of the inland spread of zebra and quagga mussels perfectly illustrates the problem. When the first zebra mussel turned up in North America in 1988, biologists knew the fast-reproducing mollusks native to the Caspian and Black Sea basins would spread, they just didn’t know how fast—or how far. One year after a group of Canadian college students doing field research stumbled upon the first invasive mussel specimen in Lake St. Clair, the small lake in the river system connecting Lakes Huron and Erie, the foreign mollusks that hitched a ride into the lakes aboard a freighter sailing up the St. Lawrence Sea-