

Battle on the river

In a desperate effort to sniff out a stealthy invader, scientists are lifting genetic fingerprints from Chicago waterways. Does it work?



GARY PORTER / GPORTER@JOURNALSENTINEL.COM

The Chicago River has become a key battle point in the fight to halt the spread of Asian carp. A canal built in the late 1800s to clean the river of human waste helped create a pathway to the Great Lakes for invasive species of fish.

When an Army Corps of Engineers general teamed with a Rhodes Scholar to fish for Asian carp DNA in the Chicago River, both hoped it might help win the battle to protect the Great Lakes from yet another invader. Instead, they ended up in a federal court fight over how much weight you can put in a mere molecule.

By DAN EGAN • degan@journalsentinel.com

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 thousands — would be carcasses by the time the winter sun slipped below the horizon.

The Chicago Sanitary and Ship Canal looked like a crime scene on this gray morning of Dec. 3, 2009. Yellow police tape laced the banks. Roads to the water's edge were blocked by local police officers shivering in the cold, unable to explain to passers-by exactly what had happened. Behind the barricades, a generator thrummed outside

a huge command tent with computer work stations and coffee for the 400 federal, state and Canadian fishery workers who had descended on the canal from across the Great Lakes region.

Just outside the tent, the bosses of the operation had corralled a cluster of news reporters at the water's edge to tell their story. They were the ones who were killing the river, they explained. They had decided to poison it because they were at war — with a fish.

“I can sum up my comments in six words: It's time to man the barricades,” John Rogner of the Illinois Department of Natural Resources said as President Barack Obama's handpicked Great Lakes czar, Cameron Davis, stood rigidly at his side. “For nearly 10 years we've watched as two species of introduced Asian carp — the big-



JOURNAL SENTINEL FILES

Silver carp, agitated by the hum of boat motors, take to the air, becoming a danger to boaters and a hit on YouTube. Water skiing and jet boating have become treacherous on infested stretches of some rivers.

head carp and silver carp — have moved up the Mississippi and Illinois rivers, and now they are here. They are now at the gates to the Great Lakes and our action over the next several days is designed to protect those gates.”

Such a large-scale chemical assault on a North American waterway — one that would ultimately cost taxpayers about \$3 million — was unprecedented.

But the stakes on this stretch of canal, just 35 miles downstream from Lake Michigan, were high, and not just for the health of the Great Lakes. The year before, in the heat of his 2008 presidential campaign, Obama had wooed the eight Great Lakes states — including the prized purple battlegrounds of Minnesota, Wisconsin, Michigan, Ohio and Pennsylvania — with a promised “zero tolerance” policy for species invasions in the lakes that are already an unstable stew thick with 186 foreign fish, mollusks, plants, bacteria, viruses and various other invaders.

Now exotic species numbers 187 and 188 were finning their way toward the world’s largest freshwater system, a drinking water source for 40 million U.S. and Canadian residents and a home to a multibillion-dollar fishing industry.

It was no wonder the Obama administration’s Davis, the former president of the Alliance for the Great Lakes, was dispatched to the battlefield.

Asian carp are like nothing this continent has ever seen. As fishermen in the carp-infested Mississippi basin will attest, these fish don’t just invade. They conquer. They do it by attacking the food chain from the bottom, stripping away the plankton populations that — directly or indirectly — sustain all other fish species. Specimens of bighead carp can grow to more than 100



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David Lodge (right), a University of Notre Dame ecologist and a former Rhodes Scholar, turned to DNA in an effort to stop the spread of the Asian carp.



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The Asian Carp Rapid Response team works in 2009 after fish toxins were dumped in the Chicago Sanitary and Ship Canal, a step taken to control the invasive fish.



COURTESY OF METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO

The Chicago Sanitary and Ship Canal was built to protect Lake Michigan from wastewater. Construction of the 28 miles of canal cost approximately \$30 million in the late 1800s. This photo is a scan from a glass plate negative, dated May 22, 1895, and shows dynamite blasting through bedrock during construction.

pounds and eat up to 20 pounds of plankton per day.

Silver carp are smaller but have become YouTube sensations because of their penchant for rocketing out of the water like missiles when agitated by the hum of a boat motor. They regularly send boaters to

ABOUT THIS STORY

This story draws from research compiled since 2006. It involved more than 100 interviews and is based on a review of thousands of pages of documents, including court filings, government reports, scientific research papers and archival materials.

emergency rooms with concussions and split lips. Water skiing and jet boating have become treacherous on heavily infested stretches of river in the Mississippi basin. Imagine the trouble these fish could cause in the Great Lakes states, home to more than 4 million recreational boats, about a third of the U.S. total.

“I’m likening this action to chemotherapy,” the Obama administration’s Davis lamented on the day the plan to poison the canal was announced. “Nobody wants to go through chemo, but you do it to protect the good cells from being overridden by the bad cells. That’s what this is.”

Now, at midmorning on the day of the poisoning, Rogner was assuring reporters the fish kill was going precisely as planned. But there was a problem. Among all the dead bass, bullhead, gizzard shad, suckers, common carp and catfish bobbing to the surface, no one had found a single Asian carp.

Two men in particular had a great deal at stake in the blind hunt.

One was Maj. Gen. John Peabody of the



CINCINNATI ENQUIRER

Maj. Gen. John Peabody of the U.S. Army Corps of Engineers made boyhood trips to the Lake Erie shore. That’s one of the reasons he is so invested in the fight against Asian carp.

U.S. Army Corps of Engineers, a gruff sort who seems to spend most of his waking hours in combat fatigues. Peabody backed temporarily closing the canal to barge traffic to allow the poisoning after his agency had turned to a cutting-edge method for sniffing out fish by searching for telltale traces of their DNA, a practice better known to criminal forensics than to water management.

This carp-hunting technique, so new it had yet to be peer-reviewed or published in a scientific journal, had been pioneered by David Lodge, a University of Notre Dame ecologist with an impeccable reputation — a former Rhodes Scholar — whom Peabody had teamed with to find the “leading edge” of the invasion. Lodge’s sampling indicated



COURTESY OF METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO

Excavation of the Chicago Sanitary and Ship Canal lasted from 1892 to 1900. The 160-foot-wide and 24-foot-deep artificial waterway allowed the City of Chicago to reverse the flow of the Chicago River, sending its sewage into the Mississippi River basin instead of Lake Michigan.

that the fish had arrived at the site of the poisoning.

Like a quarter-century ago, when DNA analysis emerged as a bafflingly powerful tool to convict murderers and rapists, reporters at the canal had many questions about how this environmental DNA sampling — dubbed eDNA — actually worked. But the man with the answers wasn't there. Lodge was 103 miles away, stuck in South Bend because he had a class to teach. He was also growing anxious as he followed news hitting the Internet that hinted the whole slaughter might turn out to be a boondoggle based on unproven science — his unproven science.

By late afternoon, thousands of fish were dead or dying. Government crews chased after them in a ragtag armada of motorboats. The scene looked more like an amateur fishing tournament than an orchestrated government attack. Some who had been brought in for the kill wore government-issued orange flotation suits, others wore ill-fitting life jackets under camouflaged hunting duds as they tried to net and identify each surfacing fish.

Night fell. Still, in all the barrels of toxic carcasses headed for a landfill — ultimately the poisoning of the canal would yield about 54,000 pounds of flesh — there was no word of even one Asian carp.

Lodge's water samples might have indicated that the carp were indeed invading, but the fish floating to the surface told

a different story. The general would soon be left with a stark choice. He could trust what the DNA evidence had revealed, that the canal — and Lake Michigan — was apparently at the earliest stages of a biological invasion. Or he could trust his eyes.

An unnatural disaster

The station wagon pulled up to the brown brick federal research lab in eastern Arkansas loaded with a radical new weedkiller. It was a brisk November day in 1963, a time when there was an increasing awareness of the potential perils of all the herbicides and pesticides flowing down our rivers, across our croplands and orchards, into our grocery aisles, onto our dinner tables.

A clamor was growing for a smarter, gentler approach to combating unwanted creatures and vegetation. Researchers at the U.S. Department of Interior's Fish Farming Experimental Laboratory, located in the heart of Arkansas catfish country, were trying to do just that when they took delivery of what they hoped would be the next generation of 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 chem-

ical 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 researcher at the Arkansas lab.

“It was one fish to do one job — keep chemicals out of the environment.”

Instead, it opened the door to what could shape up to be a billion-dollar biological blunder.

That station wagon’s payload was the first documented shipment into the United States of the group of fish collectively known as Asian carp. Within a decade of the grass carp’s arrival, Arkansas fish farmers would import three other carp species: black, bighead and silver.

These four fish are almost cartoonish in that each has its own particular invasive superpower. Grass carp devour stringy vegetation; black carp gobble mollusks; bighead and silver vacuum up free-floating plankton. All have escaped into the waters of North America, but it’s the bighead and silver carp that have caused the most trouble and now threaten to turn the Great Lakes into what some government officials have called one giant “carp pond.”

It is an ecological and economic mess nobody saw coming. The fear at the time the fish arrived was whether researchers could even get them to reproduce, because breeding the fish in hatcheries proved to be an absurdly intricate procedure that required precise timing and water conditions, as well as injections of crushed fish pituitary glands and human hormones harvested from the urine of pregnant women.

So nobody was worried in the early 1970s when a fish farmer got in touch with the Arkansas Game and Fish Commission and arranged to turn over a batch of bighead and silver carp he’d unintentionally imported while attempting to buy his own crop of grass carp. State fishery workers could have destroyed these Adams and Eves. Instead, according to the personal records of the fish farmer housed in the archives at the University of Central Arkansas, the state hatchery workers decided to try to get the novel brood to reproduce.

They had no luck until Taiwanese aquaculture expert S.Y. Lin was flown in from his United Nations’ posting in Washington,

D.C. Lin took two 12-pound silver carp and hatched nearly 1 million tiny silver carp fry. He fertilized the eggs from one 15-pound bighead and made about 20,000 baby bigheads.

It wasn’t long before the Arkansas Game and Fish Commission 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 Mike Freeze explained that Arkansas waterways in the 1970s were like everywhere else in the country — ridiculously filthy, in part because small communities didn’t have adequate sewage treatment systems.

So Arkansas turned to the carp. Phase One of the state’s plan was to plant bigheads and silvers in experimental sewage lagoons and let them convert human waste into fish flesh. Phase Two would be to sell those fish as food to fund small cities’ sewage treatment costs.

“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. Then the federal Food and Drug Administration swept in. “They had a standing policy that it was not legal to take these fish out of sewage ponds and sell them for human consumption.”

The experiments soon stopped when federal funding dried up. Some fish were destroyed. Others were simply set free.

Freeze, who has retired from the Game and Fish Commission and is now a private fish farmer, looks back at his days working in the state’s Asian carp breeding program and remembers containment screens swinging open and gates being lifted to drain hatchery ponds — and their inhabitants — into Arkansas streams.

Freeze said he believes there were subsequent escapes from research facilities in Northern states, but he acknowledged that these Arkansas bighead and silver carp almost surely were the first to get into the wild. Ever since, Freeze has ruefully followed from afar their migration north toward the Great Lakes — the grandest water bodies the fish could ever hope to colonize.

“I’m old enough and big enough to say that there are a lot of things in my life that I’d go back and change,” he said.

Blind justices

While there are several potential pathways for the jumbo carp to make their way into the Great Lakes, by far the biggest is the Chicago Sanitary and Ship Canal. It is a 160-foot-wide and 24-foot-deep artificial waterway that opened in 1900 in an audacious

move by Chicago leaders to keep their city booming.

Before the canal was built, Chicago flushed its sewage and industrial waste straight into the Chicago River, which oozed like foul lava into Lake Michigan — the source of the city’s drinking water. The flaws of such a sewage system are as obvious today as they were fatal then; news reports from the 1890s show that as many as 2,000 Chicagoans were dying from typhoid fever each year.

Eventually Chicago city planners decided to build a canal that would reverse the direction of the city’s namesake river so that it flowed out of Lake Michigan and into the Mississippi basin. That would allow Chicago to literally flush its waste toward the Gulf of Mexico and provide an economic boost to the region by opening a barge corridor between Chicago and New Orleans.

It’s not surprising that the city of St. Louis, which to this day draws its drinking water from the Mississippi River, did not want to start drinking Chicago’s sewage, even watered down as it was by the time it flowed into town.

In January 1900, the State of Missouri petitioned the U.S. Supreme Court to block the canal opening. That prompted Chicago leaders to sneak out of town in the early hours of Jan. 17 and open the 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.

“Water in Chicago River Now Resembles Liquid,” a *Times* headline deadpanned.

The Mississippi River basin and the Great Lakes have been unnaturally connected ever since.

The reversal solved Chicago’s drinking water troubles, but in making its case to the Supreme Court, Missouri reported the annual number of typhoid fever cases in St. Louis approximately doubled in the four years after the canal opened compared with the four years prior. Even so, Missouri had a hard time convincing the justices of the Supreme Court that Chicago toilets were the problem.

It was the turn of the 20th century, and the science of microbiology was in its infancy. The plaintiffs contended that the typhoid bacillus could survive the eight to 18 days it took for Lake Michigan water to travel the 357 river miles down 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, 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 the justices apparently trusted their eyes.

“The plaintiff’s case depends on an inference of the unseen,” Holmes concluded in dismissing the case.

The typhoid fever troubles largely evaporated with advances in sewage treatment and water purification in subsequent decades, and Illinois’ Great Lakes neighbors learned to live with a slightly diminished Lake Michigan because the canal was built to siphon away up to 6 billion gallons of water per day (the subject of another Supreme Court case filed by Wisconsin in the 1920s). But by the late 20th century, the larger, unseen 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 invasive species to spread across the continent.

Unwanted species often initially enter the Great Lakes via the St. Lawrence Seaway — a separate canal system hundreds of miles to the east that created an artificial shipping link between the Great Lakes and the Atlantic Ocean. Ships sailing up the seaway have delivered dozens of unwanted species into the lakes since it opened more than a half-century ago.

The Chicago canal has turned this regional problem into a national one that is ever-growing as species migrate from the Great Lakes to the Mississippi — and beyond. Pipe-clogging invasive mussels native to the Caspian Sea region metastasized out of the Great Lakes through the Chicago canal and now threaten billions of dollars’ worth of irrigation and power-generating infrastructure as far away as Nevada and California.

But trouble floats both ways on the canal. Scientists have identified 39 additional invasive species poised to ride its waters into or out of the Great Lakes.

In 1996, trying to slam the invasive species

door that Chicago unwittingly opened, Congress funded a “demonstration” electric barrier on the Chicago canal, about 25 miles southwest of downtown. The barrier was designed to shoot a round-the-clock, fish-incapacitating jolt into the water and stop invasive species from swimming out of the Great Lakes and into the Mississippi basin, which sprawls across some 1.2 million square miles — about 40% of the Lower 48 states. Such barriers had been successful on streams and irrigation canals, but never on a waterway this big, 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 \$1.5 million contraption went into service in 2002. But by then the Great Lakes invasive fish that scientists had feared would use the canal to escape into the Mississippi basin had already done so. The barrier was then repurposed as a device to halt the migration of Asian carp into the lakes from the other direction.

Not long after the demonstration barrier went into service, federal officials became convinced it was worth funding a more robust version built to last decades and operate at four times the strength of the original.

Construction of the bigger-and-better barrier started in 2004 but was not finished until 2006. Then it took nearly three years for the government to actually turn it on. The delay was due largely to U.S. Coast Guard worries about electricity arcing between barges, some of which carry petroleum and other flammable materials. Barrier safety studies were dragging on into early August 2008, when a no-nonsense Army Corps general arrived to take charge of the carp fight.

John Peabody’s résumé reveals an engineer who might fit in as well with jarheads as gearheads. He’s a 1980 graduate of West Point who has done tours in the Pacific, Panama, Somalia and, most recently, the Middle East, where he led 3,000 engineers into Iraq during the 2003 attack on Baghdad.

In his three decades in uniform, Peabody 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 54-year-old general limps on a metal hip. He has a penchant for quoting war movie dialogue. He’s brusque with subordinates.

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 bas-

kets, 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!’ ” said Peabody. “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 fish 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, and 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,” Peabody said in an interview this year in Vicksburg, Miss., after his transfer from the Great Lakes region to the Army Corps’ Mississippi Valley Division.

Lake Erie’s pollution problems in the 1960s — including fish-littered beaches and the burning of the Cuyahoga River — helped prompt Congress to pass the 1972 Clean Water Act, and since then Lake Erie and the other Great Lakes in many ways have made a remarkable recovery.

But while chemical contaminants have been greatly reduced, the lakes today are plagued by a fresh pollution: their 186 non-native species. These foreign organisms have so ruptured the natural order of things that a commercial fisherman from 1900 on the water today might fret he’d sailed off the globe and landed on another planet altogether, one where things like quagga mussels, round gobies, sea lamprey, fishhook water fleas, alewives and bloody red shrimp clutter his nets instead of lake trout, yellow perch and sturgeon.

The problem is more than just an ecological changing of the guard. The brew of exotics has unleashed noxious algae outbreaks that smother beaches in foot-deep goo that looks like creamed spinach and smells like the bowels of a porta potty. Invasive species have spawned botulism outbreaks in fish populations that have dominoed up the food chain and killed tens of thousands of birds. Great Lakes invaders are also suspected of triggering outbreaks of microcystis, which produces a potentially deadly liver toxin for humans.

If Asian carp invade the Great Lakes, biologists are not exactly sure how much damage they would cause, because the lakes’ plankton populations have already been decimated by zebra and quagga mussels. But there is compelling evidence that carp could at least thrive in the lakes’ warmer bays and harbors — places where fish and humans tend to congregate.

A history of Asian carp in the United States

■ **1870s:** U. S. Fish Commission, a predecessor to the U.S. Fish and Wildlife Service, begins a hatchery and fish planting program for common carp, a popular food fish that had been imported from Europe.

■ **1893:** Common carp are recorded in the Great Lakes.

■ **1963:** U.S. Fish and Wildlife Service imports from Malaysia the first grass carp to the federal research facility in Stuttgart, Ark.

■ **1966:** First believed escape of those fish.

■ **1970:** State of Arkansas begins planting grass carp in weed-infested waters across the state.

■ **1973:** An Arkansas fish farmer, seeking his own stock of grass carp, receives a shipment of grass, black, bighead and silver carp from Taiwan. This is believed to be the first record of bighead, silver and black carp arriving in the U.S., though some accounts place the bighead's arrival in 1972.



Photo: "Draft Management and Control Plan for Asian Carps in the United States," April 2006

The first grass carp shipment from Malaysia was delivered Nov. 16, 1963, at the U.S. Fish and Wildlife Service laboratory at Stuttgart, Ark.

Silver carp

Both species are filter feeders, relying primarily on plankton.

Bighead carp

7 ft. 6 5 4 3 2 1 0

■ **1974:** The Arkansas Game and Fish Commission, which agreed to take the bighead, black and silver carp from the fish farmer, begins attempting to breed those fish.

■ **1979:** Arkansas Game and Fish, working with a grant from the U.S.

Environmental Protection Agency, undertakes sewage treatment experiments using silver and bighead carp.

■ **1980:** Silver carp reported swimming in the wild.

■ **2002:** Experimental electrical barrier installed on the Chicago Sanitary and Ship Canal, about 35 miles from the Lake Michigan shoreline. That same year biologists find bighead carp about 21 miles downriver from the barrier site.

■ **2003:** A common carp is tracked swimming through the electrical barrier. Operators crank up the

power, and the barrier fails for 25 hours. Biologists don't believe any Asian carp passed through the barrier during the power failure.

■ **2004:** Ground broken on new, more robust barrier.

■ **2009:** New barrier turned on, but not at voltage strong enough to repel juvenile fish. In November, first positive DNA samples arrive showing evidence of fish above the barrier. Coalition of Great Lakes States responds by turning to the courts to force the U.S. Army Corps of Engineers and State of Illinois to do more to stop the fish.

■ **2011:** Barrier turned up to voltage strong enough to repel juvenile fish. Positive DNA samples continue to come in showing evidence of fish beyond the barrier in Chicago canal waters.

■ **2012:** University of Notre Dame reports positive DNA samples in Lake Erie.



Source: U.S. Army Corps of Engineers; Journal Sentinel research

Journal Sentinel

Peabody knew the carp were a real threat to the lakes when he walked into the job, and he says he was "absolutely determined" to beat them back, even though he didn't sense that same commitment from his sister agencies. "It seemed like we were the one agency trying to do something," he said as he ran his hands through his spiky black hair. "It's not that other agencies weren't interested. It's that it wasn't high on people's radar screens."

In the months after he took over the job, Peabody turned on the new electric barrier but authorized it to run only at the same voltage as the nearby demonstration barrier, 1 volt per inch, even though it was designed to run as high as 4 volts. One volt does not provide a strong enough jolt to stop a juvenile fish, but it was a level the barge industry could live with and, at the time, the closest visible Asian carp population was about 15 miles downstream.

"If the fish weren't close enough to be a threat, it didn't seem prudent at that time to raise the (barrier's) operating param-

eters," Peabody said.

That was a big if, and Peabody knew it. Population modeling that used the pace of the Asian carp's migration up the Mississippi and Illinois rivers indicated the fish should have long ago been probing the barrier area, even though crews using nets and electro-shocking 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.

The nets might have been coming up empty, but Peabody was nervous nonetheless.

"Our lack of information was so great. I felt we had to take whatever we could and apply it as quickly as possible to try and get more information," he said.

Then he paused and drew a deep breath through his nose.

"So we did that. I think you know the rest of the story."

Wednesday: Water samples at the barrier turn up DNA evidence of Asian carp, but where are the fish?