



Black age spots on buffalofish are believed to arise from sun exposure, yet the species does not appear to get skin cancer. New discoveries place native buffalofish among the longest living of all animals and longest lived of all freshwater fish. Nearing age 100, they enter their prime—physically improving with better immune and stress responses. The oldest known reached age 127. Iowa's oldest to date was age 70.

The Staggering Secrets of *Buffalofish:*

Recently discovered as one of Earth's longest living animals, they defy notions of aging by improving over time.

STORY BY BRIAN BUTTON PHOTOS COURTESY STUART BLACK

Often ft-maligned, ignored or mistaken for carp or an invasive species, these gentle giants are recently netting some in-depth attention, accolades and concern for their well-being as researchers uncover mind-warping biological feats rarely found not only among freshwater or marine fish, but all animal life. And their secrets will make age-obsessed, fountain-of-youth-seeking people green around the gills.

Meet our native buffalofish, largest of North America's sucker family. Found statewide in interior rivers, lakes and the Missouri and Mississippi Rivers, its range extends from Louisiana into Canada and spans much of the mid-continent thanks to the massive watersheds of those two big rivers.

Once thought to live perhaps 20-25 years, newer findings shatter that. These fish not only age without signs of typical physical decline or apparent skin cancers—but become more robust and healthier as they reach extreme age.

Iowa's three buffalo species, bigmouth, black and smallmouth, have long

been a food source. With entry into the First World War in 1917, Yanks arrived to Europe's trenches at a rate of 10,000 men a day, ultimately mobilizing over 4.7 million military personnel. To feed them, government campaigns encouraged citizens to eat less meats and more fish as every pound of meat required many more pounds of valuable grains to produce. But fish feed themselves with insects, plankton and aquatic plants—none of value in war.

So in 1917, Iowa fisheries staff near Marquette and McGregor rounded up thousands of small fish from the Mississippi River, put them into 10-gallon metal milk cans and loaded them onto the state's several railroad "fish cars" used to stock Iowa waters. But this train car was Arizona bound—a wartime mission to stock the recently filled Theodore Roosevelt reservoir 80 miles northeast of Phoenix on the Salt River. On board were nearly six thousand bass, catfish and perch and three species of juvenile buffalofish estimated about 420 in sum.

Over a century later, a group of Arizona anglers became fascinated by some large buffalofish they were catching and releasing a few miles below Roosevelt Dam on another dammed section called Apache Lake. The big fish had unusual markings—orange or black spots. Curious, they searched online for answers. They dove deep, hooking into published research led by Dr. Alec Lackmann, a young, energetic assistant professor at the University of Minnesota Duluth.

Lackmann ventured to Arizona three times in 2021-22 to age 23 fish. The oldest black buffalo was age 108. A bigmouth buffalo was age 105. These are possibly the same fingerlings from that train. A smallmouth buffalo aged around 101 would have hatched in the early 1920s—early offspring of its parents. More than 90 percent of sampled

buffalofish here are at least 80 years old. It's Earth's only known lake with three species of centenarian fish together.

Just a few years earlier, Lackmann began investigating buffalofish and devised aging techniques specific for their otoliths, those calcium-carbonate structures found in the inner ears of about 97 percent of all fish. "Otoliths are the gold standard for age analysis," he says. While otolith aging exist for thousands of marine and freshwater species, "this species largely wasn't studied or researched," he says.

Otolith size and shape varies by species and fish have three different sets. It can be difficult to create very thin cross sections needed to discern and tally growth rings or annuli under a microscope, akin to counting tree rings.

His first aging work on 18 bigmouth buffalo in Minnesota had astounding findings. They were all over 80 years old. The findings elicited skepticism and reactions of "there's no way that's possible," Lackmann says. "I couldn't believe it myself. I was like, 'this doesn't seem right.'" He reviewed more aging research techniques, aged 20 times more fish and consulted fellow experts to spot errors. Nothing fishy—they backed his results. "That's when I knew, 'wow, there's something pretty interesting here.'"

AGING USING ATOMIC BOMB PULSES

Not wanting any doubts and seeking bomb-proof evidence so to speak, Lackmann and colleagues did more tests to assess carbon-14 isotope levels in otoliths with a special form of radiocarbon dating using "bomb pulse" forensics.

Peaking from 1950 to 1963, hundreds of aboveground nuclear bomb tests by the U.S. and Soviets caused a spike in carbon-14 in the atmosphere, doubling the natural amount of this exceedingly rare isotope. It has since declined by about

In 1917, buffalofish from Iowa were stocked in Arizona. A century later, Phoenix angler Stuart Black noticed spots on fish he was catching. He later learned these were age spots—on very old fish.

Save the products of the Land Eat more fish — they feed themselves.

In 1917, government posters during the First World War promoted eating fish to save feed grains and meat for the troops. To help, Iowa fisheries staff sent fish to stock a new reservoir in Arizona. A century later it was shown that some of those same fish are still alive.

BULL, C. L., ARTIST (1917)/RETRIEVED FROM LIBRARY OF CONGRESS

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UNITED STATES FOOD ADMINISTRATION IOWADNR.GOV 23

4 percent a year as it enters oceans, lakes and land and its life forms. It's a good measuring stick. Everything alive carries these markers—sort of a hidden time signature.

Measuring and comparing it against his annuli ring counts, “That spike in C14 happened where we would expect if those rings were indeed annual,” he says. The age estimates were legit.

They later collected 52 random buffalofish at the northern area of their range in Saskatchewan. “It was pretty striking,” he says. One bigmouth buffalo was 127 years of age, shattering records. Then he found a second of similar age! “Around 80 percent of that population was more than 70 years old in that sample size of 52 fish,” including seven super-centenarians over 110 years in age, he says.

Buffalofish now rank among the longest living of all animals on earth and among the longest of all freshwater fish. And these elders soon revealed ever-greater secrets.

AGE SPOTS, NO SKIN CANCER?

“You could sometimes see spots occurring around 40 years old. That’s right around the time when they really start appearing,” Lackmann says of fish studied up north.

Age spot patterns identify individuals. Arizona anglers use photos to track fish. They’ve caught and released 180 individuals mostly hatched from 1920-23. They’ve even named some. “Buffalo Gill” is the group’s mascot, homage for Buffalo Bill Cody, born in Iowa along the Mississippi River. These conservation anglers use barbless hooks and quickly release fish.

“We don’t know definitively why those spots are occurring—the mechanism,” Lackmann says, “but we think it’s fairly likely black spots are some artifact of sun exposure over time.” Other animals and humans get age spots, too.

Skin cancer should be highly likely with a century-plus of daily sun exposure. Buffalofish even bask—loafing in bright, sunlit surfaces. Yet black age spots seem to pose no harm. “They’re not getting skin cancer it appears...it’s interesting to think how they do that,” says Lackmann. Is there a protective, natural sunscreen in their slime coat? Are cells making repairs that human cells cannot? These secrets could have huge human-health benefits as skin cancer is the most common cancer in the U.S.

Spotting has nuances. Some water systems have same-aged fish with less spotting. Water quality and habitat could be at play. Cloudy or “turbid water systems tend not to produce as many spotted buffalo even at an older age range,” he says.

For orange spots “it’s probably coming from carotenoids in their diet over time getting bio-accumulated and expressed for whatever reason in their skin,” says Lackmann. Orange spots are more linked with bigmouth which feed differently from the other buffalofish species—less near shore or bottoms and more in open water on microscopic plankton which can be rich in natural carotenoid pigments.

This Arizona buffalofish named Coral shows orange splotches along with black age spots. The orange color likely arises from natural carotenoid pigments from their plankton diet. Anglers use unique spot patterns to identify individual fish before release.



DEFYING AGING BY IMPROVING IN OLD AGE

In another study, lead researcher Derek Sauer, then at North Dakota State University, along with Lackmann and others, looked at tissue and blood samples of bigmouth buffalo to measure immune function, stress response and the length of telomeres—protective end segments of DNA that tend to shorten over time which may to lead to physical aging that biologists call senescence.

Compared to younger fish, “immune function and stress response got better with age even at 100 years old,” and telomeres were not shortening, says Lackmann.

“Bigmouth buffalo up to a hundred years old are exhibiting what’s called negligible senescence. They’re actually still improving in physiological condition at that age,” he says. “They’re still getting into their prime. It’s incredible that a vertebrate animal can live a hundred years yet still get better with age. It’s just remarkable,” he says.

With two known buffalo aged near 127, “It just begs the question. What is it in their DNA repair mechanism or ability to withstand mutation,” asks Lackmann. Will they reach some advanced age and then rapidly decline or decline gradually? No one knows. “There’s just so much more to learn,” he says.

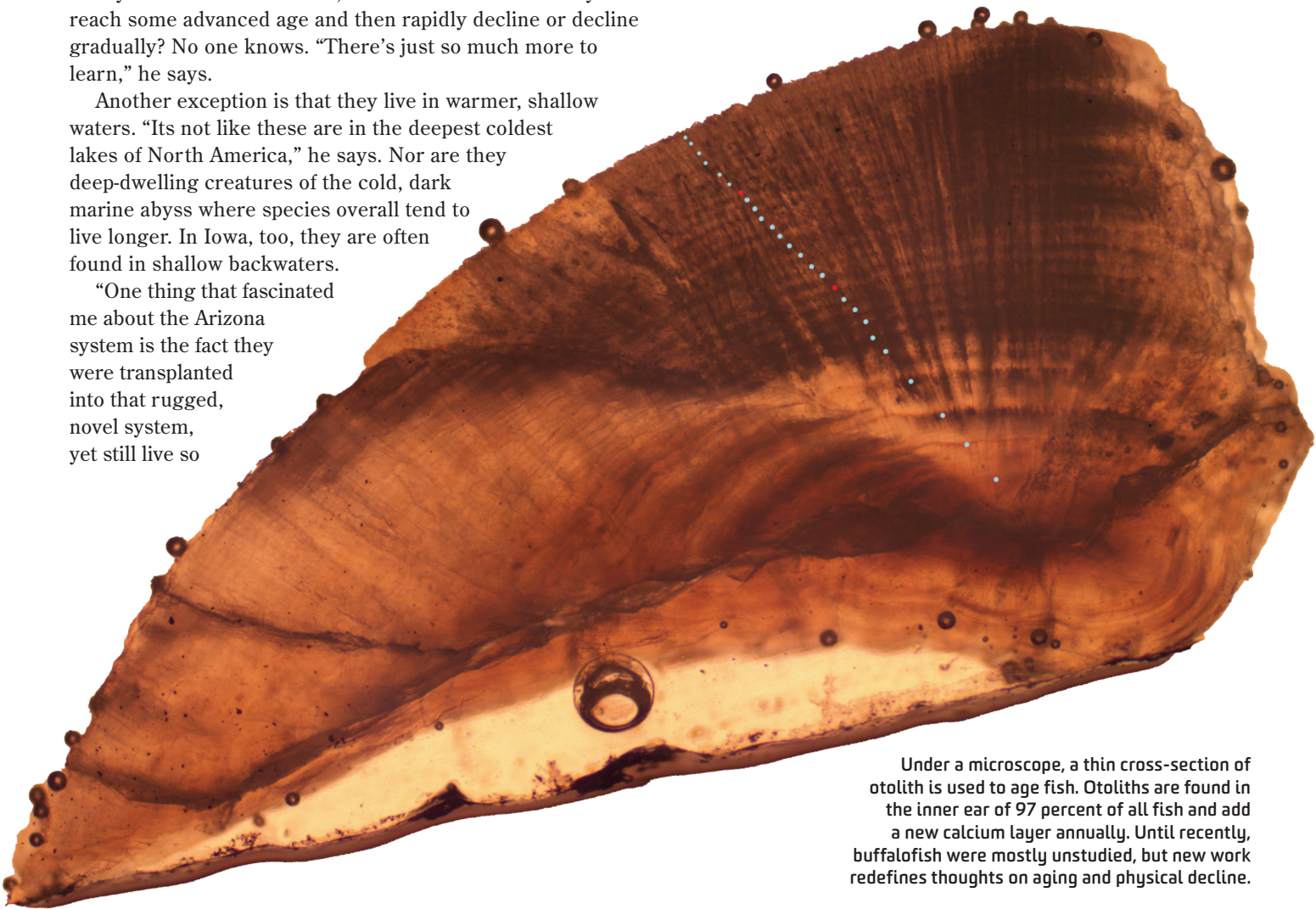
Another exception is that they live in warmer, shallow waters. “Its not like these are in the deepest coldest lakes of North America,” he says. Nor are they deep-dwelling creatures of the cold, dark marine abyss where species overall tend to live longer. In Iowa, too, they are often found in shallow backwaters.

“One thing that fascinated me about the Arizona system is the fact they were transplanted into that rugged, novel system, yet still live so

long. You’d think if anything they’d live shorter lives and die younger if thrown into that,” he says.

Yet upon stocking in 1917, those fish soon had big spawns from 1920-23. Most fish swimming there now are of that era, with a few original 1917 fish likely swimming, too. As Arizona dams filled and waters rose, fish were in virgin territory with lots of energy in a new food chain. Did that lead to rapid reproductive success? Absence of populations from later decades is another mystery. This species can have long age gaps between generations that span 50-60 years. In some areas, populations average above age 80. Due to longevity, are they patient in awaiting ideal spawning conditions, playing the long game versus a reproductive sprint? There are concerns about their future in some lakes and other systems. Without protections or newer generations reaching adulthood, the species may crash locally.

For a species so long ignored and unstudied, perhaps the lowly buffalo fish is now just getting its moment in the sun. In areas of its native range, hopefully it’s not a sunset. 🌅



Under a microscope, a thin cross-section of otolith is used to age fish. Otoliths are found in the inner ear of 97 percent of all fish and add a new calcium layer annually. Until recently, buffalofish were mostly unstudied, but new work redefines thoughts on aging and physical decline.

Buffalofish in Iowa and their Future Elsewhere

For a species recently thought to maybe reach age 25, new discoveries have identified individuals aged 127. Now buffalofish are the oldest age-validated freshwater fish on Earth and among the longest living of any animals.

Ryan Hupfeld, a DNR fisheries biologist and researcher based in Bellevue, along with Lackmann, aged buffalofish in Mississippi River pool 13 from Clinton to Bellevue, finding ages spanning 5 to 37 years. He aged another from the lower Wapsipinicon River to age 70. While old for many species, it’s still young for buffalofish. So why no super-elders here?

With attention on buffalofish fairly new, “I don’t think we know a lot for one,” he says. “But with work done here, we’re not seeing those old ages for a number of reasons. First, it’s hard to know the natural, historical age structure of buffalofish on the Mississippi River, he says. Such data is non-existent all along the river.

Second, commercial fishing could have “cropped off some of those older fish,” says Hupfeld. Commercial fishing from 1942-82, harvested three million pounds of fish per year in Iowa alone. Buffalofish are part of those totals along with other species. Commercial fishing continues and fortunately buffalofish still grow to catchable sizes with consistent reproduction and recruitment to the population in the Mississippi.

In some areas in their range, buffalofish fail to reach adulthood and gaps in generations may span 60 years, perhaps due to predator fish consuming eggs and fry. As older fish are caught, populations are dwindling in Minnesota, North Dakota and Canada.

But here, the main channel of the Mississippi and Missouri Rivers act as a conduit or hub for buffalofish which can migrate huge distances up tributaries. On any river or creek, the ability of fish to enter floodplains during spring spawn or

for young fish to forage is of immense benefit. Eroded creek, stream and riverbanks often make that impossible even during high spring water levels. Many banks are unnaturally too high. Levees, especially on interior rivers, also make it impossible.

Hupfeld and other DNR biologists evaluated different species during a flood. “We collected young-of-year fish in the floodplain and main channel and fish growth rates were significantly larger from the floodplain. They can avoid predation more effectively due to increased floodplain cover and increased growth rates,” he says. Freshly flooded lands offer a feast—vegetation, insects and more. “Whenever we see high water during the right time in spring, most species have massive amounts of natural reproduction and recruitment to the population,” he says. “Connection to floodplains provides a lot more food which leads to higher growth rates than if confined to the main channel.”

Invasive species can also affect native buffalofish. “We are keeping an eye on movement upstream of invasive carp—silver and bighead carp, because they directly compete with every fish on the river at a young age and bigmouth buffalo for their entire life since they’re feeding on the same food resource,” says Hupfeld. “We don’t have high densities of invasive carp in Iowa as they do in states farther south, but they are expanding. It’s a concern for us.”

Bow fishing also limits their ability to reach extreme age as large fish in shallows are often targets, not for food, but killed for fun or a photo op. Piles of arrowed buffalo can be found on banks or in trash cans. Some think they are helping rid waters of an invasive fish or a carp. Buffalofish are neither. Ironically, these native fish compete against invasive fish for food and space.

This isn’t a trash fish, but a remarkable species with a slow pace of life unlike nearly any animal on Earth due to its longevity and anti-aging feats. Perhaps attitudes can change.



Near Arizona’s Teddy Roosevelt Reservoir, a fish nicknamed Teddy sports a fin with an ink-like age spot. Three species of Iowa-origin buffalofish here are over a century old.