OKLAHOMA'S PADDLEFISH RESEARCH AND CAVIAR PROGRAM

Brandon Brown

Oklahoma Department of Wildlife Conservation, Medill, OK

When you think about caviar, spoonbill catfish and Miami, Oklahoma probably aren't the first two things that come to mind. But thanks to a healthy Paddlefish (*Polyodon spathula*) population and an innovative conservation strategy, Oklahoma has become one of the nation's largest caviar producers. In fact, during 2013 alone, nearly 20,000 pounds of Paddlefish caviar were produced and sold by the Oklahoma Department of Wildlife Conservation's (ODWC) Paddlefish Research Center.

Paddlefish (aka spoonbills) are named for their oversized bill (or rostrum) and are one of North America's most bizarre and primitive fish. The popular misconception is that they use their bills to "stir up the mud" and scavenge on detritus, but Paddlefish are actually filter feeders and live almost entirely on tiny zooplankton strained from the water column by their huge mouths and baleen-like gill rakers. Their highly specialized rostrums are used to locate food and are covered with sensitive electroreceptors capable of detecting even the most minute electrical currents. Research conducted at the University of Missouri St Louis determined that their rostrums are so sensitive that juvenile Paddlefish are even capable of detecting the electric field *of just one individual plankton*.

Long-lived and slow to mature, female Paddlefish are often eight or more years old before producing their first viable eggs. Egg production requires an incredible metabolic investment and nearly one fourth of their body weight may consist of roe. Increasing water temperature, photoperiod, and river flow trigger upstream spawning runs where adhesive eggs are broadcast over submerged gravel bars and hatch unattended. Growth is rapid for the first few years and in Oklahoma they may reach 12" during their first growing season.

Paddlefish occur throughout eastern Oklahoma in the Red, Cimarron, Arkansas, Verdigris, and Grand/Neosho rivers, but are most abundant in the northeast corner of the state. According to Jason Schooley, Paddlefish Biologist for the ODWC, "Paddlefish are native throughout the Mississippi River drainage, but due to dam construction and habitat alteration their numbers have declined throughout much of that range. In Oklahoma they're a species we're concerned about, but luckily we have a relatively stable population." Schooley goes on to say that Paddlefish are particularly abundant in the highly fertile Grand River system, which includes Grand, Hudson, and Fort Gibson reservoirs.

Jason is one of Oklahoma's two full time Paddlefish biologists, positions that didn't even exist until the creation of ODWC's new Paddlefish Research Center (PRC). Schooley spends most of his time conducting Paddlefish research and population surveys and says that "Paddlefish are a species that we've been monitoring for a while, but until our Paddlefish Research Center came along we never really had the resources to do as much as we wanted with them. With limited man-

Biologist Jason Schooley with a 107-pound OK Paddlefish.

Young-of-the-year Paddlefish bred for the Asian aquarium trade before CITES banned its export. (Aquarium-blunted rostrum; does not occur in round pools.) (Photo by Konrad Schmidt)

power and funding, we just never had enough time or money to devote specifically to managing Paddlefish." That is, until 2008, when ODWC opened the PRC and began an "outside the box" new program that generated much needed data for management decisions and alternative revenue for research and law enforcement.

Roe sales provide badly-needed revenue for Paddlefish research and enforcement.

The PRC is a cooperative partnership between Paddlefish fishermen and the ODWC. Anglers voluntarily participate in the program by donating their fish to the research center where biologists measure length and weight, and take gonadal fat, and about a two inch piece of the fish's jaw. According to Schooley, Paddlefish have cartilaginous skeletons (meaning they don't have bones), but their hard jaws are bone-like and cross sections contain growth rings not unlike those found in trees. Biologists can read the rings and age the fish similar to the way a forester ages trees. The rings can even reveal at what age a fish reached sexual maturity. Once the age is determined biologists can compare fish lengths and weights at a given age to determine growth rates.

Knowing the fish's age also helps biologists keep track of past spawning success. Paddlefish aren't like bass or crappie that start spawning every year once they get a couple years old. If you have a bad crappie spawn, chances are they'll be successful next year and natural reproduction can quickly offset any effects of a failed or meager year class. Paddlefish on the other hand are episodic spawners, meaning they require exact circumstances to spawn, conditions that might only present themselves every few, or even several, years. This, combined with the fact that Paddlefish don't typically reproduce until they are about 8 years old, makes them particularly vulnerable and slow to recover from overharvest. In the northern part of their range, it wouldn't be unusual for a Paddlefish to live up to 50 years, but in Oklahoma they'd be really lucky to live even half that. So when you look at things from that perspective, a 15-year old Paddlefish might have only had one or two good chances to reproduce before it succumbs to natural mortality—even fewer if it's harvested by an angler before then.

Angler satisfaction and participation in the Paddlefish Research Program is high.

Schooley also explains how the gonadal fat is used as an indicator of Paddlefish fitness. "Before they reach sexual maturity Paddlefish feed almost constantly. They grow fast and pile on fat reserves that surround the testes and ovaries. But once they reach maturity most of their energy goes into reproduction and growth slows dramatically, especially for females because all the fish's energy is devoted to producing eggs. This is very metabolically expensive and they simply can't eat enough to produce both eggs and body growth. The amount of fat accumulated before becoming sexually mature is very important and not just for seeing them through the spawning runs, but possibly the rest of their lives." He also adds, "It's interesting to note that most males don't get over about 45 pounds or so, but sometimes we see these really large, 80–90 pound fish come into the center with big bellies and they look like egg-laden females, but when we process them we find that they're actually males. Big males with huge fat reserves, sometimes a five-gallon bucket or more of fat. These males are sterile; they don't devote any energy to spawning, but instead are able to put all their efforts into growth. These fish are really rare, but when we see them it's always impressive to see how much fat they've stored."

In return for their donation anglers get their fish professionally cleaned, processed, and packaged for free. Fishermen can even call a Paddlefish hotline and PRC staff will pick the fish up at their boat while they're still on the water and deliver their catch alive to the center. When the anglers are done fishing for the day, they can swing by the research center and their fillets will be packaged and waiting for them on ice. Tim Miller, ODWC's other Paddlefish biologist, explains that "Paddlefish have a layer of dark, off-flavor meat and are hard to fillet. Because of this most are cut into chunks or steaks and then the red meat is trimmed away—an often messy and time consuming process. In our processing center we have specialized equipment and personnel who are able to remove the red meat and produce fillets with a minimum of waste. Anglers receive the same fish they checked in and get a nicely packaged fillet that looks just like you'd see in any fresh fish

market and they don't even have to get their hands dirty."

If the donated fish is a female, the roe is processed into caviar and sold to fund the program and other fish and wildlife research projects around the state. According to Oklahoma's Paddlefish guru Brent Gordon, the caviar produced in Oklahoma is considered Malossol "little salt" and with a few exceptions, is prepared similar to the way caviar has been prepared for centuries. It's also some of the highest quality produced anywhere and most is sold to overseas brokers in Europe and Japan. To date nearly 100,000 pounds of domestic Paddlefish caviar have been produced at the center.

Gordon's official title is Paddlefish Research Supervisor and he's spent nearly his entire career working with Paddlefish. He explains that the PRC's caviar sales have benefited not just the ODWC and Oklahoma paddlefish, but Paddlefish throughout their range. "Our caviar is sustainable, we rigorously follow Food and Drug Administration (FDA) and Convention on International Trade in Endangered Species (CITES) regulations, and are closely monitored by the US Fish and Wildlife Service. Our buyers know that our product is from a renewable source and is 100% legal and from a FDA-approved facility. That's a huge benefit for them."

The color, texture, and taste of Paddlefish eggs are very similar to that of sturgeon and as traditional sturgeon fisheries like the Caspian Sea have collapsed due to overfishing; demand for other high quality caviar sources has increased sharply. To meet this new demand, thousands of pounds of wild caught Paddlefish roe have been harvested by both legal commercial fishermen and illegal caviar poachers in Oklahoma and other states. "A big female can have from 10 to 20 pounds of roe, at about $135 dollars a pound wholesale, that means a female Paddlefish can be worth well over $1,500. That's a big temptation for a lot of people and we know that illegal harvest has occurred in Oklahoma and other parts of the country as well" said Gordon. He went on to say that since 2008, the PRC has produced enough domestic caviar to meet a large part of the market demand. Having such an abundant supply helps keep market prices low and consequently, that makes it more difficult and less lucrative for poachers to sell their roe. "With our product buyers don't have to worry about where the caviar is coming from or how it was produced. They can buy from us and not have to take any chances on quality or illegal activity. So an unintended, but welcome, side effect has been that our program has likely benefitted Paddlefish in other states by making it harder and less profitable for poachers to do business."

ODWC's caviar sales have also helped curtail Paddlefish poaching by providing much needed money for law enforcement personnel and equipment. Oklahoma game wardens have received night vision and FLIR thermal imaging equipment, as well as work boats and side scan sonar to help wardens patrol and do surveillance for illegal netting and night time activity. This increased law enforcement benefits not just Paddlefish, but other wildlife species as well.

Since the center opened in 2008, biologists have collected data from nearly 30,000 Paddlefish. To put that in perspective, during the ten years prior, the ODWC was only able to collect similar data from about 200 fish. "To get the data we need we have to sacrifice the fish. Those 30,000 angler-caught fish were already harvested - they were going to die anyway, this way we get our data and we don't have to kill any fish. Our fishermen have essentially become data collectors for us, it's a win - win program, it's good for the fishermen and it's good for the fishery" said Gordon.

According to Gordon, the data collected at the center has already been used to implement regulation changes that have created spawning sanctuaries, catch and release only days, a mandatory Paddlefish check system, and reduced daily and season limits. He also explained why the new regulations are so important for sustaining the fishery. "Age and growth data have revealed that the Grand Lake 1999 year class was unusually high. This provided above-average catch rates beginning in the late 2000s as those fish reached maturity and began making spawning runs. Those fish are now 15-years old and are starting to die from natural mortality. In addition, because that year class was so large the fishing was really good for several years and fishermen were getting accustomed to having high catch rates. So we have a situation where fishing pressure is increasing, but the resource is just beginning to decline. Because of this program we have the data to see the downturn looming on the horizon and have been able to proactively create a few new regulations that will help us manage the population." He also added that 2008 and 2009 were both years with flows well above average and they are hopeful that those years had high spawning success. "But that's something we won't know for sure until those fish reach sexual maturity and start making their spawning runs. Like it or not it's something we're going to have to wait another two to three years to find out".

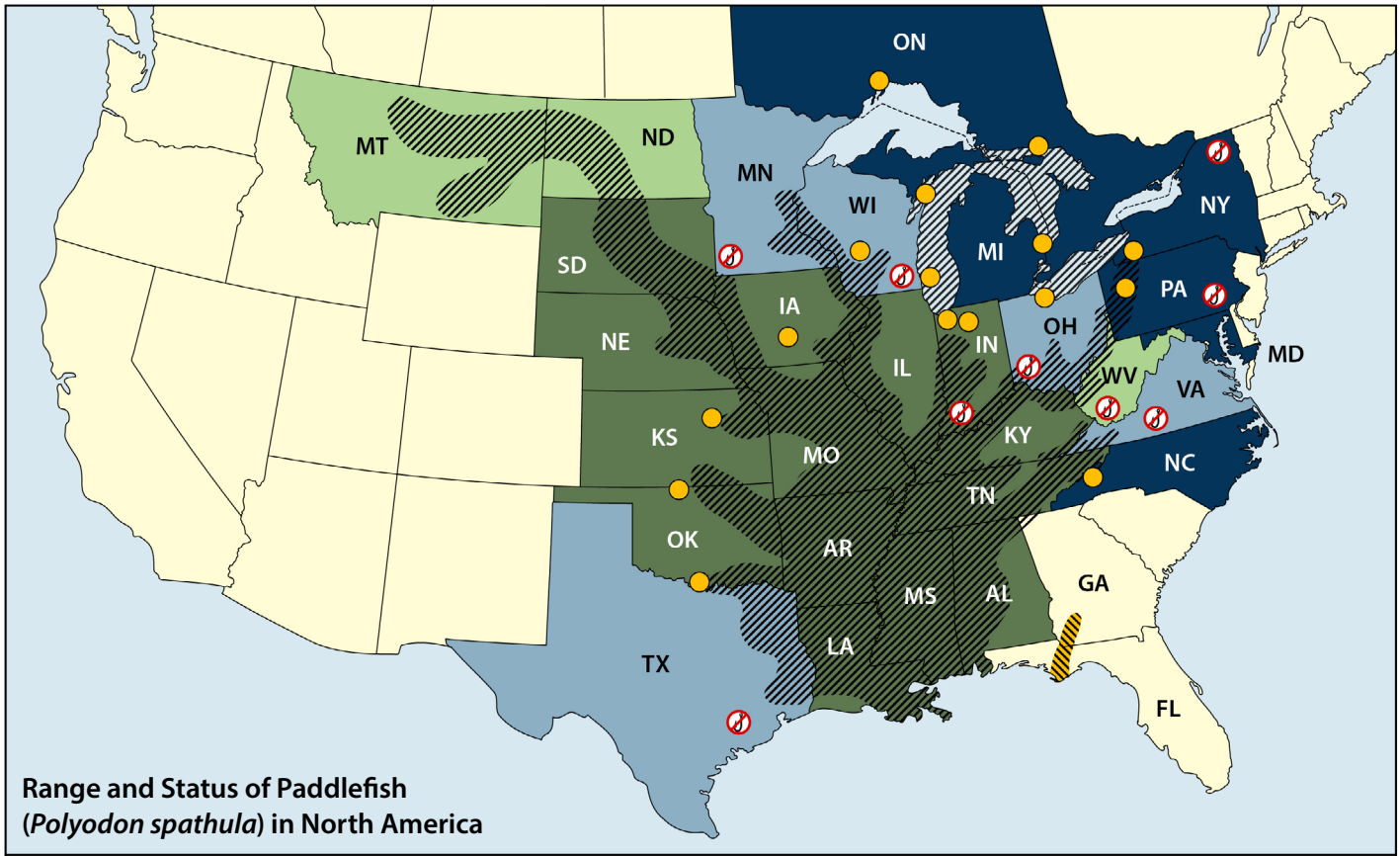
Schooley reiterated how crucial good data are for making accurate management decisions and said that prior to opening the PRC, the ODWC had little idea how many people were fishing for Paddlefish or how many were being taken. "Today we know that in a typical eight-week season we'll have about 3,000 Paddlefish anglers with about 2/3 of those being from other states. Our nonresident fishermen come from all over the country and each year we've been open we've had anglers from all 48 contiguous states. We're especially popular with fishermen from Iowa, Nebraska, and South Dakota—all states that have Paddlefish populations of their own.

In addition to collecting data at the PRC, Gordon, Miller, and Schooley spend their winters conducting mark and recapture surveys to estimate Oklahoma's Paddlefish popula-

tion size. Using large-mesh gill nets they capture as many fish as they can and attach a small metal tag to each fish's jaw prior to its release. Netting is conducted during the coldest months of the year, when the fish's metabolism is slowed and the process is less stressful on the fish. "Doing our netting in the winter makes things hard for us, but it's better for the fish" says Schooley. "A lot of times we're out there when temperatures are in the teens or even single digits. Sometimes the nets start freezing the second we pull them out of the water. But that's the best time to handle the fish because when the water's below 50 degrees their metabolism is very slow, so we can tag them with little worry about handling stress or delayed mortality. The more fish we can tag, the better" says Schooley. "We can compare the ratio of tagged to untagged fish that are harvested by anglers and caught in our nets. Then we plug those numbers into mark and recapture equations and can get a pretty good estimate of our population size."

"We're first and foremost Paddlefish biologists, we're always going to do what's best for our Paddlefish population. That's our number one goal, we actually see the caviar sales as a fortunate byproduct of those efforts" says Gordon. He adds that another unexpected benefit of the program has been the relationships the ODWC has formed with its constituents. "Prior to opening the center, the ODWC had little presence in rural northeast Oklahoma. The only real contact people had with our agency was if they were contacted by one of our game wardens. Now we talk to thousands of anglers every year. We're providing a service for them, they see what we're doing with the money the program generates, and we're building one-on-one relationships with them; I don't really know how you can put a price on that."

The Paddlefish Research Center is located near Grand Lake, four miles north of Twin Bridges State Park on highway 137. The center is open Saturday, Sunday, and Tuesday through Thursday from March 1 through April 30. Only live and legally taken and tagged fish are accepted. For more information contact Program Coordinator Brent Gordon at (918) 686-3673.



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