

Hey to all you fish enthusiasts out there! Whether you're an avid angler or just curious about fish, we'd like to welcome you to Fish of the Week, your audio almanac of all the fish. It's Monday, October 31 2022. This year, we're excited to take you on a week by week tour of fish across the country with guests from all walks of life. I'm Katrina Liebich with the US Fish and Wildlife Service in Alaska.

I'm Guy Eroh, and it's Halloween. So we're going to be getting troglobitic in the Lone Star State talking about some Texas blindcats. I'm really looking forward to this episode. This is one you know, when Katrina and I are trying to find episodes. There's lots of ways that we come into them. But we just had one space left in the year we're looking at Katrina asked me "Guy, what's the one fish or group of fish you want to talk about? Just choose one." And I..."it's got to be the blindcats." And luckily, we're able to get this guest to agree to talk to us.

Okay, and I'm really happy to introduce our guest: Dean Hendrickson, Curator of Ichthyology at the University of Texas's Biodiversity Center, and also a Blindcat enthusiast. And since it's Halloween, can I also say Satan enthusiast for the genus of the species?

You got it! Yep, that's me.

Okay, we're really pleased to have you on the show and excited to learn about the North American blindcats and also what's swimming beneath San Antonio, because Satan is not alone down there, is he?

No, definitely not. So in Texas, there are three species of Blind catfishes. Two of them live deep under San Antonio in the Edwards Aquifer. And in another part of the Edwards Aquifer, which is connected to the part from the San Antonio is the Mexican Blindcat, which just barely gets into Texas as far as we know so far. Most of its distribution is in Mexico, specifically in the adjoining state of Coahuila. But in Texas, there are just those three. Mexican Blindcat, Widemouth Blindcat and the Toothless Blindcat.

You mentioned that Satan, which is the Widemouth Blindcat. My mama would get on my case if we didn't ask where this Satan name came from.

It's actually quite simple. So the species was described by two rather famous ichthyologists back in the 1940s is when they described it. And it was Carl Hubbs, very well known ichthyologist and his buddy at University of Michigan Bailey, so they describe the species. And think...it lives deep underground. It's this strange devilish looking critter, you know, it's a nasty predator in this crazy environment that's unstudied, and inaccessible to humans underground. It's the underworld of San Antonio. So Satan, I don't know what discussions led them to put that name on it. But it's pretty cool they did. I think

All the way back in your days as an undergrad student in ichthyology studying this stuff you were really drawn to the Blindcat fishes. I'm curious if you can remember the first time that you ever stumbled upon one of these in the wild? And if you can recollect that story to us.

Well, actually, it wasn't in the wild. I had experience with these things well before I went looking for them in the wild. So I remember when I came and interviewed for my job, and people, of course, were asking, "Well, what research would you do?" And these blindcats were high on my list. Everybody knew that I was interested in those when I came here. And the guy in the office right next door was a caveman vertebrate biologist. And so he hooked me up with all these cavers that were interested. There's a huge community of Austin cavers that go to Mexico all the time. And so word got out that Hendrickson was looking for these blindcats, and please help him out. And lo and behold, one day, probably within my first year, shortly after that of being in Austin, I go in my office one day, and there's this icebox sitting right in front of my office door. And I open the lid, and here's half a dozen blind catfish swimming around. And some cavers had been in Mexico, and they remembered and they boxed these things up and drove him up and put them on my doorstep, literally. So that's what started the live colony. And what really got me motivated to go after the ones in Mexico basically, it's of course, if I had them, I could study them in the lab, and that helped open doors to funding for the expeditions and stuff like that.

That's great.

That's an awesome gift to just walk into.

It was yeah, it was really pretty amazing. Yeah.

Could you help us imagine what it would be like to be a blindcat and what life is like in an aquifer deep down below?

Good question. That's a good way to start this out. We know now from some recent molecular studies on a couple of them anyways, that they've been blind for probably 30-40 million years. Living down in these aquifers is they lost their eyes long ago. So if you just imagine being blind from birth, basically and living in a totally sightless environment, that's a start. And if you were down there for millions and millions of years, all of your other senses would be fine tuned to replace what vision would normally give you, right? They have incredibly sensitive detectors of vibrations of sound, and chemical, taste, and smell like senses, that sort of thing. All of that is hyper emphasized in all of these blind critters. So there's a lot of evolutionary studies interested in these things, because they're basic laboratories where we can explore evolution of all of these different characters having to do with the underground.

Would you be able to describe what exactly these fish look like for folks who haven't seen maybe a catfish or haven't seen these types of cave fishes before?

Yeah. So basically, very first, specimens were recognized as catfish, right, they have the typical barbels the uncanny things of the cat fishes have especially Satan anyways, they're quite obvious on Satan, not so much on *Trogloglanis*, and *Trogloglanis* has this bizarre mouth unlike any other catfish. But in that way, they look like catfish. They don't have obvious scales, which is also like catfishes, right? At least the families we're talking about. So a very smooth skin, they're completely de-pigmented. Basically, pigments on the surface are there to protect things from the sunburn and stuff like that, right? So when they went underground, there was no need for any kind of pigmentation. And it's not used for breeding

or anything, there's no visibility. So they've long ago lost all pigmentation. So fresh in life, they come up looking quite pink, basically, their skin is translucent. And you can see the blood right through them. But you can see the eggs in females. So as they start to mature, you can see these great big eggs, they just pretty much look like very bleached out little catfish.

I think it's really cool how this demonstrates the biological cost of things like eyes, and melanin and things like that, that we take for granted. As soon as you go out, you don't need them producing that stuff. Not only is it not necessary, it's detrimental, but just gets forced out of the gene pool. So I think it's just a little insight.

No, yeah, you're completely right. And that whole process of adapting to caves, has been very well documented in several other fish systems that have invaded caves. So they've become evolutionary models for a lot of adaptation sorts of things like that.

I know fish don't have huge brains on them. But I assume that there's like an area that specific, like, kind of corollary to the optic lobes and stuff that we got, has anyone looked at the brains to see how those might change in cave fishes?

Actually, yeah, there was an early study that looked at both *Trogloglanis* and *Satan* in that regard. And they did a lot of sectioning of skulls, and demonstrated that, for example, the optic lobes are reduced, as you would expect. And then the olfactory lobes and all those sorts of things that have to do with hearing and smell and taste and all that are much larger. So they've been hypertrophy, basically, compared to all the other lobes of the brain that are irrelevant now that vision has gone.

That's awesome. If you were to look at the skull of one of these fishes, what does the area where the eyes used to be look like? Like, how has it changed? And is there any remnant kind of evidence of eyes being there?

Oh, there's still remnants of the eyes. In fact, there's been a lot of developmental studies of the remnant eyes in these things. And in these species, they're very much remnants are totally dysfunctional. But if you look close enough, you can find that remnant I so they're not absolutely completely gone. But they're just tiny little things that are almost non-existent.

Yeah. Cool.

And are these guys in terms of searching for food like is that their primary thing they're doing is trying to find food down in there?

One would guess obviously, they have to live. So *Satan* is the top predator in the system. It's like the bald eagle of surface environments, if you want to think of it that way. So there's not much energy underground, right? You lose all the solar energy input, all that sort of thing. This ecosystem that lives in though, is hyper diverse for a cave ecosystem. There are over 100 different species of invertebrates that live down there with these two fishes. So that's what *Satan* is preying on, and it's probably preying on the other catfish, which is the Toothless Blindcat *Trogloglanis pattersoni*. It's an interesting one in

that ecologically, it's at the other end of the foodweb. This one is the one that's apparently eating bacterial production the aquifer. It's based on a chemoautolithrophic system. In this case, it's two different water bodies. There's fresh water that comes in from the Texas hill country goes underground and flows under San Antonio where it comes up against a saline sulfurous water body that extends out to the southeast deep underground. And where those two come together, you get a lot of chemical stuff going on different water qualities, and it eats away the limestone. That's the lithotrophic part of it, right? So there's a huge bacterial community that's very understudied. that lives down there in that zone that is literally living off the limestone and *Trogloglanis* has this crazy mouth, it's adapted. It's a sucker like mouth that has no teeth, but it grazes that bacterial mat. So that's what it's feeding on.

That's cool.

I'm curious. I know. It's, you're looking like 40, 50 million years ago. But what theories have been proposed about how these fish got down into the aquifers in the first place?

Well, you think about catfish. They're nocturnal, right? Almost all catfishes are mostly nocturnal. So they're out at night. They're on the surface adapted to having senses that work in the darkness. So they're sort of predisposed to going into caves. And almost all catfishes at least in North America, utilize cavities in the bank or whatever, for nesting at least, and that sort of thing. And even the surface species often extend far into caves. So just their lifestyle predispose them to life in the darkness. So when these aquifers started evolving, they were exploring those caves. And pretty soon they ended up way down there.

Okay, and how far down are these guys? They're pretty far down aren't they?

They are they're like 1000 feet plus down. Okay, so way down there.

So we've talked about Satan, the widemouth, we talked about the Toothless, but we got a third one.

The one you're talking about there is the Mexican Blindcat. I think it was either in my fisheries management class, or maybe my ichthyology class that I first heard about the Blind Catfishes. And they just got my attention way back then, when I was an undergraduate, many years go by and I scored this job in Texas, and I'm much closer to Mexico. I've had been working for my dissertation in Mexico. And I knew about that Blindcat. And one of the first things I did was get some funding to go chasing them. And we found them at a whole bunch of new places great project expeditionary work, going into all these caves searching for these things, and greatly expanded their distribution and got them right up almost into Texas. And then the hydrologist, later, studying border aquifers determined that that aquifer was not just a Mexican aquifer, it extends under the border into Texas. So it's an internationally shared aquifer. We knew that some of the species of isopods and other critters other invertebrates we're finding were in both Texas and Mexico. And so we anticipated that this blindcat might actually be in Texas. And when we got a chance to start snooping around in caves on the Amistad National Recreation Area, with some Park Service funding, we were thinking hot damn, here's our chance, maybe we're going to find it finally. Sure enough, they turned up in Texas. And so we added a new species to the Texas one of them. That's super cool. Yeah.

How are the different ways that you're accessing the aquifer? You mentioned, perhaps going in to caves that sounds really cool.

There's huge differences depending on the species. These two in San Antonio are just whole world different from the ones in Mexico. The Mexican Blindcat is not in such a deep aquifer, there are at least two or maybe three places where you could, with some luck, find them actually on the surface and just walk up to a pool in a little bit of a cave and scoop them out. But those are really rare. Most of them the area is karst and you get these interesting "sotonos" they're sinkholes, they're kind of like the cenotes de Yucatan. But these are deep. The waters way down there. You go down into sort of a funnel at the top, and then you get on rope and you drop probably 30, 40 meters, some of them up to 100 meters, just a straight drop rappelling down. And down there you find these streams that are flowing through these little caves, you can typically stand up for a while you explore them and then you'll have to dive under a low shelf and crawl around for a while and then you come back up and high ceiling again. You can tell that they flood massively just like the surface streams in the area do. You get these big rainstorms and they find their way underground and underground the floods are amplified because they can't spread out right they just go up. So you drop into these holes in the ground and you start looking and there's mud 20 meters up on the walls. You go "oh man, I definitely don't want to be here in a rain."

Oh my goodness.

It's kind of spooky. But once you get down there if it's not the rainy season, they're nice clear streams. You can see the Blindcats swimming around, they're quite easy to scoop up.

That's super cool.

But then compare that to San Antonio, the habitat of the blindcats and that aquifer is completely inaccessible to humans. The only way we know that the catfishes are down there is because about 1900 San Antonio at that time was running out of water, and somebody put these wells and they're actually artesian wells. They're under pressure. So you punch a hole in the earth and boom, water comes spraying up. It's like a Gusher. And some of those very first gushers spit out blind catfishes. And so I think the first one was the first described in 1990. That was a gusher that just spit out some *Trogloglanis* and perhaps Satan weren't looking for. Some just happened to find their way to scientists or in the museums. But that's the only way down into those habitats where the catfish live would be through those wells. And not only would the pressure be way beyond what scuba divers could tolerate, the wells just simply aren't big enough to get a human sized object down the the other big problem is access to those wells in the city of San Antonio had been completely dependent on aquifer water for many decades. And then in the 1990s, they were sued by a conservation group concerned about endangered species that were dependent on natural spring flows coming from the same water that would pass through the blindcats' habitat, and then surface, little ways north of San Antonio. So the Supreme Court said, "you have to assure that aquifer is never going to drop below X level. Because below that level, there's not going to be enough flow for these endangered spring fishes." We understood it but it was really frustrating. But back then it was understandable because the only way we have specimens of these things is either by them coming up naturally through the Artesian flows. But

then those artesian flows started to go away as the water aquifer was dropped. And so that wasn't happening anymore. And so the only way to get these things was to put nets over these big well outputs. You can't sample the old way for specimens anymore. So that's been a huge impediment. The last specimen of Satan was taken in 1984. So we don't know if it's extinct down there or just very rare. Or maybe other wells still have them. Anyways.

You guys use an eDNA?

So basically, when eDNA started to catch on, it's like, well, bingo, this would require almost no water.

eDNA being environmental DNA for people listening.

Thanks. Thanks. So basically, all organisms slough off DNA all the time. In an aquatic system that's carried by the water so you just take a small water sample, you filter out the eDNA, extract it, sequence it, and if you're lucky, in this case, well known sequences that say, "oh, bingo, there are blindcats down there.

Or Satan's down there.

Well, Satan is the exception, or we don't have DNA of it yet, so we don't have a target. So Satan is still a shot in the dark, until we get another specimen from which we can get DNA or we finally figured out how to get good DNA out of formalin-preserved specimens, we won't have a known for Satan, whereas we finally did get some fresh specimens of *Trogloglanis*, and we've got the whole Mitogenome of *Trogloglanis* now. So we have those fixed targets. And we will be able to say, "oh, yeah, there is *Trogloglanis* down there." Same with the Mexican Blindcat, we have Mitogenomes for those two. So we're well set for doing DNA except for Satan.

Do you have any messages for landowners or folks with wells that I guess could maybe lead to more productive engagement with that?

Yeah, we did get some support to get serious finally about trying to get permission to sample wells for eDNA specifically. That's what got this all rolling was now our ability to use smaller water samples. There are a lot of privately owned wells. We'll be approaching the San Antonio water system as well for permission to sample their wells. The Texas Water Development Board has a database of wells online. And so we can map all of the known locations for both of the San Antonio blindcats. Pick out all the wells that are in relatively close proximity to those and that are pretty much equally as deep so we can kind of filter that database down into a prioritized list of wells that look likely to have these blindcats. So we'll be working with nonprofit collaborators that are going to help us try to start contacting well owners to see if they'll allow us to take just small samples of water for eDNA.

You mentioned that they're keeping a population of these at the San Antonio Zoo. I imagine when you're dealing with a fish that's so rare, it can be hard to figure out the husbandry and stuff. Are these kind of hardy species or have they had issues with that?

No, they've had pretty good luck there. And then I had them in my lab for decades before I gave them to the San Antonio Zoo. Okay, this is the Mexican Blindcat we're talking about now should be clear. They were difficult to start with, we had problems with infections, they seemed very susceptible to abrasion in transport from the field. So by the time you got to the lab, they would have surface infections that were hard to cure, finally found an antibiotic that worked quite well for that. And then once established in the aquarium, I had multiple heart attacks, basically. I'd walk into the lab and find them floating belly up. That's just what they do. Sometimes, they float around, and they would just be absolutely totally motionless, just floating around looking absolutely dead. But they weren't. It took just the slightest tap on the glass or something, boom, they're wide awake. They're just...check back and then they'll go lay on the bottom too completely belly up.

I guess if you're in a kind of predatorless environment, you don't really need to be worrying about sleeping and sleeping positions and all that and where you're at

Exactly, just all kinds of very unusual sorts of behaviors that it took me ages to get used to. And then feeding them was never very hard, though. They pretty much ate whatever I would throw at them. And so that was convenient. But it's also what you would expect down there. Basically, that species is clearly affected by floods. And it's probably a boom or bust type thing where floods bring in all kinds of surface nutrients and they get fat. And then the stream starts drying up. And it might be years before the next flood comes along. Right. So they seem very well adapted to starvation. In fact, in my lab, some of them for 44 months without being fed.

How long can they live? Did you say how long? It's a long time it sounds like.

One of those that I collected in 1997 as an adult still lives today in the San Antonio Zoo.

Wow.

So we have no clue what lifespan might be in these things. But I wouldn't be surprised what it's 50, maybe even 100 years. You know. That's another thing that has been well-documented in cave organisms is generally much longer lifespans than their surface relatives.

No sun exposure.

Yeah, that and just low energy diet, and all these adaptations to living in a low energy world, just very low metabolic rates, all that kind of thing.

Yeah, I have a lot of family down in Texas. And so I know that Texans tend to be a pretty prideful bunch. I saw that out in Del Rio, they got a mural going up that add the dedicated to these new Mexican blindcat that were found. I'm curious what went into making that mural. And if you're seeing any changes, regarding people's appreciation for the species, or if you're not, what you might suggest to get people excited about them, because they're obviously just super fascinating.

Yeah, that Del Rio mural is really cool. It was really nice to see that happen. And the way it came about basically was we were starting to publicize our work with the Mexican Blindcat, my colleague at the zoo, and I, we've been doing a lot of caving in Mexico. So we got a bunch of Mexican collaborators and us together and we formed this little group called the Mexican Blindcat Working Group. And so we started to get a little bit of publicity with that. And then the artists that did that mural was actually hired by one of the conservation groups to do projects like that around the country, highlighting endangered species. And somehow they came up with the idea of doing the blindcat. I wanted to point out to you, but I actually hooked up with a sound artist who got interested in this system. Basically, it looks like he's going to help us get some hydrophones down into some of these deep monitoring wells. And just leave them there listening because it's totally irrelevant to our work. Most, or many anyways, ictalurid catfish, which these are produce sounds, usually in conjunction with breeding and nesting and territoriality, that sort of thing. So we're going to start dropping hydrophones down into these wells sometime and just letting them run for a while and then sending them off to the ornithology lab at Cornell. They're good at filtering sounds of organisms out from background noise, and they've done quite a bit of marine fish work. So they're keen to listen to any recordings we get, and maybe the first detection of the blindcats other than by specimens, or eDNA, could well be a sound that we can say "You know, that sure sounds like the sound of such and such bullhead or something."

I was gonna ask you, are you able to make a catfish sound? Let's hear it.

So take channel catfish. That's probably the most commonly caught catfish, right? Everybody touches channel catfish and they skin them and fry them up right? And if you have a channel catfish on the hook and you're holding it there you'll see it's pectoral spines doing this number...can you see me there?

Yeah I'm flapping my wings, my pectoral spines. At the base of those spines are these ridges that produce this sound. Kind of a "roew roew roew roew roew."

He's flapping his "wings."

Pretty good impression.

This has been a fascinating conversation. Really appreciate it.

Well, good. Yeah. It's been fun.

Yeah, I've really enjoyed it.

I can talk about these things forever, obviously. And it's good to talk more to other people about them too...

So Texas may not be the biggest state. Alaska is. But they sure do have the coolest aquifer. So get out there and enjoy all the fish including Satan and all the blindcats.

North American Blindcats feat. Dean Hendrickson

Thanks for listening to Fish of the Week! My name is Katrina Liebich. And my co host is Guy Eroh. Our production partner for this series is Citizen Racecar. Produced and story edited by Tasha AF Limley. Production management by Gabriella Montequin. Post production by Alex Brower. Fish of the Week! is a production of the US Fish and Wildlife Service Alaska Regional Office of External Affairs. We honor thank and celebrate the whole community, individual tribes states, our sister agencies, fish enthusiasts, scientists and others who have elevated our understanding and love as people and professionals of all the fish.