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Absurd Creature of the Week: The Tough-as-Hell Antarctic Fish With Antifreeze for Blood

BY MATT SIMON 02.19.15 | 9:00 PM | PERMALINK

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This fish shouldn't be alive. Though I dunno, maybe it isn't. Hard to tell with fish sometimes. Gotta get them some eyelids. © Paul Cziko

Last week I wrote about a snail with an iron-plated shell that lives around deep-sea hydrothermal vents, where the water tops 750 degrees F and toxic chemicals swirl. They're about as close to hell as you can get on Earth. But down in Antarctica, there's a polar-opposite (yeesh) ecosystem of brutally low temperatures, damn near -28.4 degrees F—the freezing point of saltwater.

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Yet even there, life flourishes. And one group of fishes, the notothenioids, swims in those frigid waters nearly carefree, thanks to very special blood loaded with antifreeze. Some of these fish have even done away with oxygen-carrying red blood cells altogether, adopting thin, crystal-clear blood that doesn't get as viscous as the temperatures

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...get as close as the temperature drop. These fishes are tougher than you. So much tougher than you.

Studying these critters is evolutionary biologist Paul Cziko of the University of Oregon, who happily drills through Antarctic sea ice and jumps into the water. Cziko is tougher than you. So much tougher than you. "It's not that brave," he says, "in part because the water is amazingly clear." So at least there's that.



Cziko cutting a hole in 12-foot-thick sea ice. You know, like ya do. © Paul Cziko

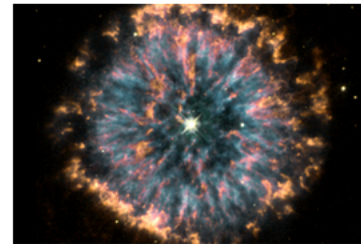
Cziko has a fancy dive suit to protect him, but most fish will get ice crystals in their blood, which grow and grow until the creature freezes solid. "We think the ice comes predominantly from the outside," says Cziko. "The fishes are drinking and eating and rubbing up against ice, and there are lots of little ice crystals in the water column that they're bringing into their bodies." But the notothenioids (which I will henceforth refer to as the notoos, because it's cute and I feel like it) have developed remarkable proteins that imprison individual crystals. "The antifreeze proteins recognize the surface of ice crystals and stick to them extremely tightly," Cziko says, "and they apparently bind essentially irreversibly to the ice crystal surface. Once an ice crystal gets into a fish, it'll get covered with the antifreeze proteins that are in the fish's blood and stop growing."

Here's the problem, though. That irreversibility means that over time the crystals build up inside the fish, and having lots of foreign objects in your blood is usually something best avoided. But these fishes live for up to 30 years without obvious ill effects, so somehow they're dealing with the accumulation of crystals. Scientists who study notoos once thought slightly warmer water temperatures in the summer allowed the crystals to melt, but Cziko and his colleagues measured temperatures

Mary Bates

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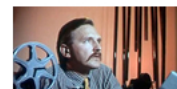
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around Antarctica for more than a decade and found the summers don't get warm enough to help any. It could be that the spleen is somehow filtering the imprisoned crystals somehow, but no one really knows. "There's no free lunch in evolution," Cziko says. "The evolution of antifreeze proteins comes with a tradeoff, where you now have to figure out what to do with the ice crystals once they get into the body." Conversely, it could be that the crystals aren't that dangerous after all. "It's really hard to prove that internal ice crystals are actually bad for the fishes. Having ice crystals in your body that could clog blood vessels certainly seems like it would cause problems. But if they didn't have the antifreeze proteins they'd be frozen solid, and they wouldn't survive at all."



To say the waters around Antarctica are bizarre would be an understatement. Anchor ice forms on the seafloor when saltwater is cooled slightly below its freezing point. This anchor ice formed on a steel cable, floating up into an arch and confusing the living daylight out of that seal, who's like lol wut.  Paul Cziko

As for the notoos with clear blood, a group known as the icefish, they have another problem entirely. They have no red blood cells or hemoglobin, and therefore have no efficient way to shuttle oxygen around their bodies. But a species like the crocodile icefish also lacks scales, and in fact its skin is translucent, so it could be that it's absorbing oxygen through its skin like an amphibian. In addition, the fish has relatively large blood vessels and a bigger stroke volume through the heart, so it drives more blood with each pump. This may seem like a dangerous evolutionary game, but thinner blood that lacks red blood cells could be invaluable. Liquids get more viscous as their temperature drops, and blood is no exception, so maybe this clear version is easier to pump around.

I know I mentioned earlier that these fish are tougher than you, and that's true in the sense that they can survive when temperatures dip below 30 degrees F. But the icefish are also in their way quite vulnerable. "You catch them on a hook and line, maybe catch them in a trawl, and bring them up to the surface and they are essentially catatonic for half an hour," Cziko says. "They're pretty beat up. Without hemoglobin, they don't easily recover from acute stresses like that."

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That syringe is indeed filled with blood—the clear variety. © Paul Cziko

The icefish, though, are voracious predators when we're not ruining their day, mostly hanging out on the seafloor targeting things like worms, shrimp, other fish, and, at least in captivity, each other. (Behavior in captivity can get a bit...eccentric, so this may never actually happen in the wild.) "You can put two crocodile icefishes of almost equal size—maybe they're a foot long or a foot and a half long, something like that—in the tank," says Cziko, "and you turn around and one of them is gone."

Life is rough, and it don't get much rougher than life in the Antarctic. But why would a creature even bother? Why not head north and find some kind of tropical paradise? Well, first of all the notoos wouldn't be able to take the heat. As with the scaly-foot snail and its hellish environment, by adapting to the hardships they've been able to make a good living because so few creatures dare join them. The living may be rough, but it's a profitable one.

Well, it is for the time being. The waters around Antarctica are some of the fastest-warming on Earth, and it's difficult to predict what that means ecologically in the future. The notoos can handle a slight bump in water temperature, "however it's their special ability to avoid freezing in icy seawater that ensures that the notothenioids dominate the Antarctic," says Cziko. "If the risk of encountering icy, freezing seawater is reduced, the Antarctic notothenioids could face stiff competition from invading fish species that don't have antifreeze proteins and therefore previously couldn't survive in Antarctica."

It's a sad state of affairs, but here's to hoping the notoos can hold on to Antarctic power. They do have the requisite bloodline, after all.

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I have to say I truly enjoy the authors style of writing. As for the US of obesity.. I think this kind of approach helps with turning back the dumbing down of America. Let the FB crowd stretch their minds for a change. Thank you for the smile and the information. I was absolutely entertained and educated. I think we need more of it.
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Realistus → anon00023 · 3 hours ago

You have too much time on your hands.

1 ^ | v · Reply · Share ·



Kude → anon00023 · 2 hours ago

This isn't an encyclopedia entry. It's not a dictionary definition. I've been coming back here in part to read the absurd creature of the week articles to learn something new, but fun. If the author takes some creative liberties with it, so be it. I don't mind one bit.

To the author, Mr. Matt Simon:

You have a fantastic series here, which is easily my favorite weekly segment on Wired. I look forward to learning a little something in every single one! Thank you for your work on it, and I can't wait to see what you come up with next week!

1 ^ | v · Reply · Share ·



Neon Frank · 9 hours ago

"-28.4 degrees F—the freezing point of saltwater"

MINUS 28.4 degrees F? Drop the "-" and you're correct. ;)

3 ^ | v · Reply · Share ·



Scottie M. → Neon Frank · 9 hours ago

Fahrenheit degrees are irrelevant anyway, nobody outside of the United States of Obesity knows how to use them. Apparently not even Americans know how to use them either

5 ^ | v · Reply · Share ·



anon00023 → Scottie M. · 4 hours ago

Because it's cool to take jabs at Americans in general. Generalizing is awesome and very accurate. /sarcasm

2 ^ | v · Reply · Share ·



Scottie M. → anon00023 · 4 hours ago

Americans are the #2 most easily trolled demographic on the web, after atheists at #1.

1 ^ | v · Reply · Share ·



anon00023 → Scottie M. · 4 hours ago

you're being an idiot

4 ^ | v · Reply · Share ·



itsallinplato → anon00023 · 3 hours ago

Let me guess: both?

2 ^ | v · Reply · Share ·



Realistus · 3 hours ago

Nottheonionoids would be a perfect name for these.

1 ^ | v · Reply · Share ·





Scottie M. · 9 hours ago

It's tough, eh? Could it survive being stepped on? I didn't think so.

3 ^ | v · Reply · Share ·



yehuda braun → Scottie M. · 3 hours ago

Oh yeah, oh yeah! Well.. well....I AM THE WALRUS! So, survive being stepped on by me!

1 ^ | v · Reply · Share ·



Dalit Kadesh · 3 hours ago

Wow!

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