A mysterious disease in Antarctic fish

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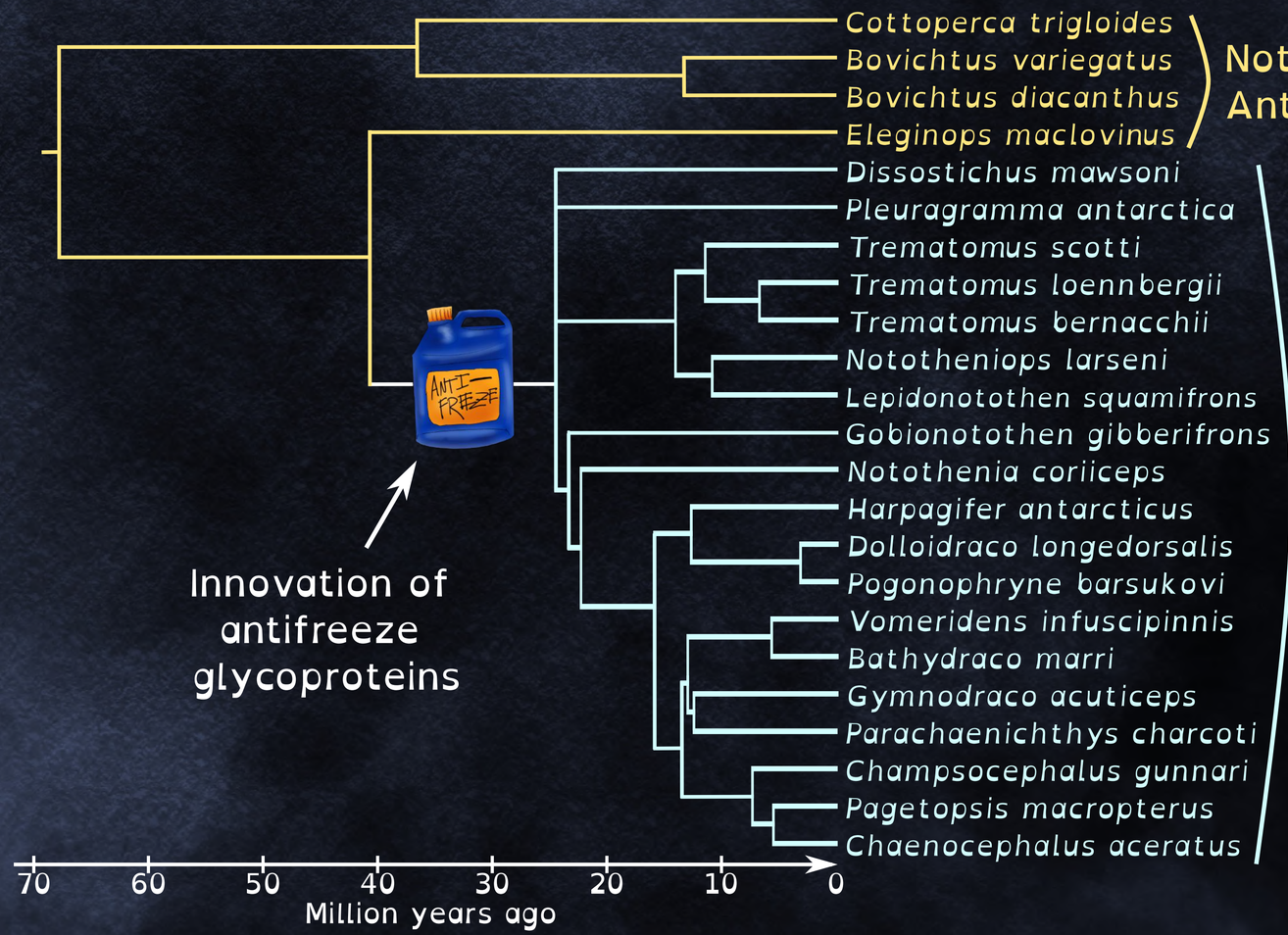
Antarctica has been chronically cold and covered with ice for millions of years.

This stable environment is now changing. Fast.

Temperatures are rising and glaciers are melting.

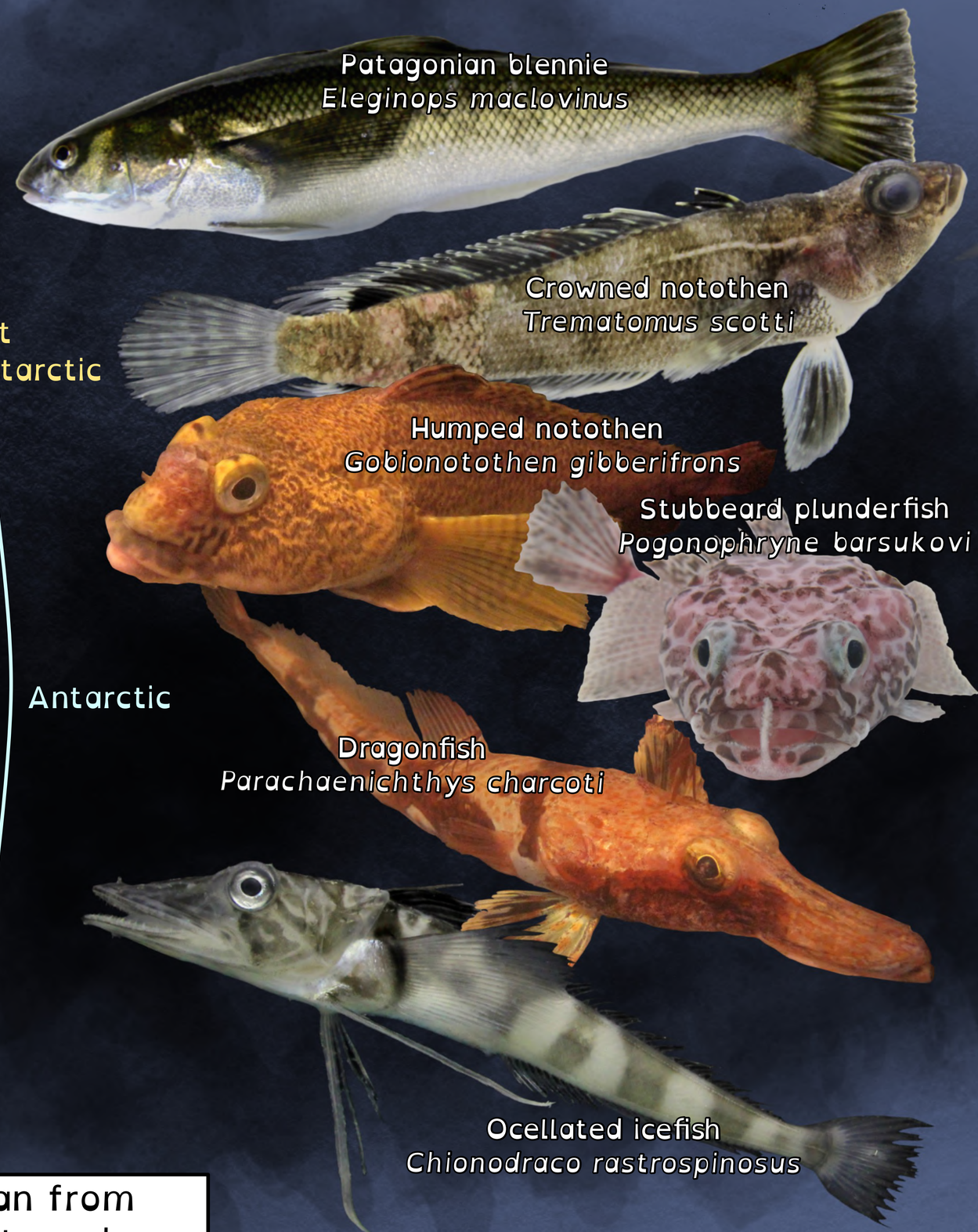
The blood and body of nearly all animals would freeze in Antarctica's ocean. But as waters cooled, an ancestor to most Antarctic fishes, which are called notothenioids, evolved an antifreeze protein that allowed them to thrive in this frigid environment.

Simplified notothenioid species tree



Around Antarctica, notothenioids diversified with little competition and predators.

Notothenioids colonized the Southern Ocean from just below the sea ice to thousands of meters deep.



Some notothenioids are called icefishes. They are really special fish!

Icefishes are the only vertebrates that don't make hemoglobin, the protein that transports oxygen around our body and makes our blood red.

Notothen blood

Icefish blood

Bullhead notothen
Notothenia coriiceps
(red-blooded)

Blackfin icefish
Chaenocephalus aceratus
(white-blooded)

Aboard the *Antarctic Research and Supply Vessel Laurence M. Gould* (the "Gould"), scientists conduct research operations in this harsh environment.

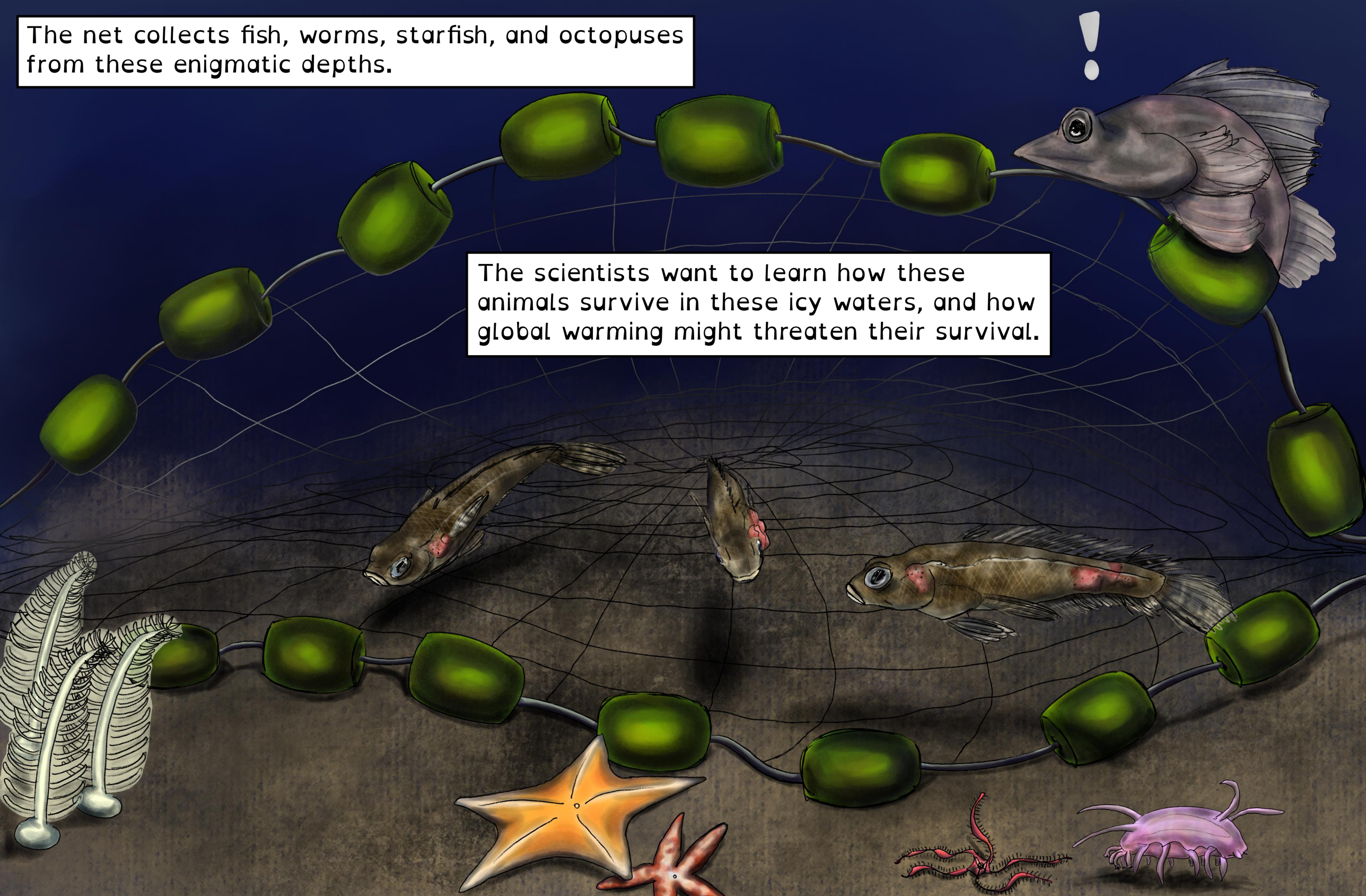
Today, the Gould explores Andvord Bay, a small fjord and hotspot of biodiversity on the West Antarctic Peninsula.

LAURENCE M. GOULD

Tonight, scientists deploy a small trawl net to the ocean bottom.

The net collects fish, worms, starfish, and octopuses from these enigmatic depths.

The scientists want to learn how these animals survive in these icy waters, and how global warming might threaten their survival.



But while sorting the catch...

Wait!

There's something wrong with this crowned notothen!

Many of these fish have strange skin tumors!

We should bring some back to Palmer and study them.

Palmer Station is the smallest of America's three permanent stations in Antarctica, housing only about 40 people.

Researchers and student scientists rotate through Palmer to study this unique environment:
its fish, penguins, whales, krill and other organisms,
but also its atmosphere, glaciers, and climate.
How have these changed over the years?

At Palmer, scientists take measurements and samples of many diseased and healthy fish for genetic and microscopic studies to learn what causes the tumors and how they affect the fish.

Crowned notothen *Trematomus scotti* #12, it has tumors. It's 14.4 cm long and weighs 50.5 grams.

Here's a sample for DNA analyses and two for microscopy. We'll study them back in the States.

Eugene, OR
USA

Dallas, TX
USA

Port Hueneme, CA
USA

Santiago,
Chile

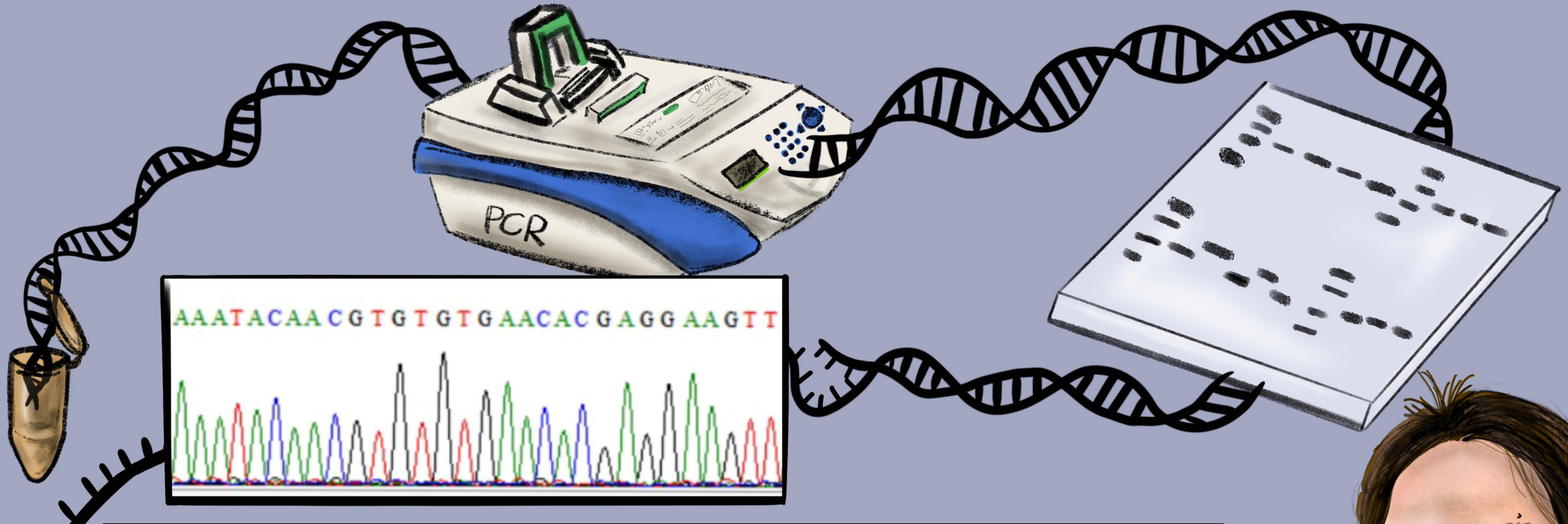
Punta Arenas,
Chile

Palmer Station,
Antarctica

After a long journey from Palmer Station to the United States, the precious fish samples finally arrive!

Let's figure out what caused these tumors!

Has a frightful deadline got you unnerved?



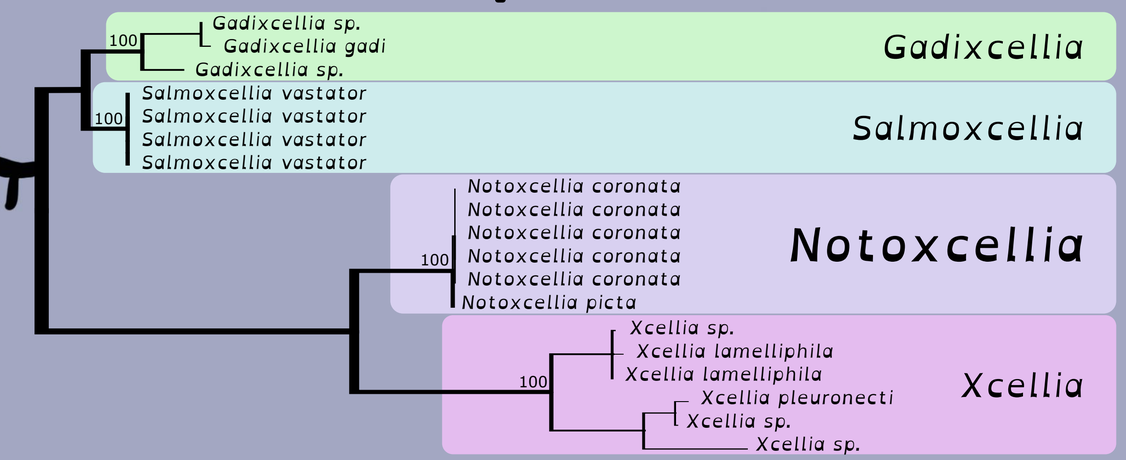
Genetic analyses using PCR tests revealed that a type of single-cell parasites caused these tumors. Scientists have seen similar parasites in cod, salmon, halibut, and a few other fishes, but rarely.

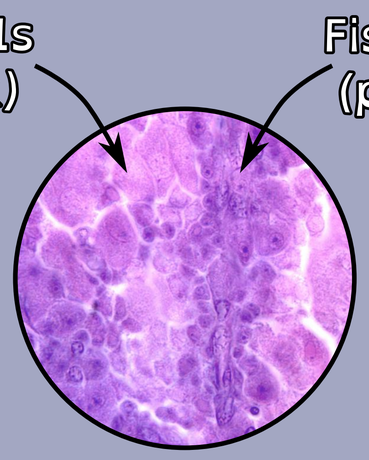
These parasites are called 'X-cells'.

But X-cells parasitizing Antarctic fishes are different from those previously described.

We called these new X-cell parasites *Notoxcellia*

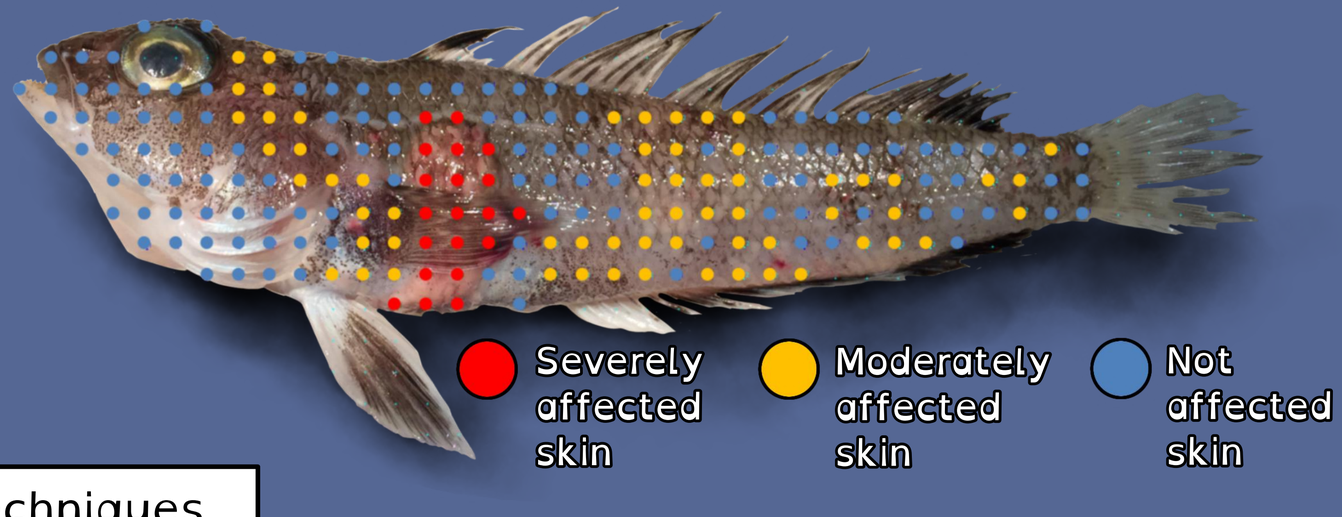
X-cell species tree



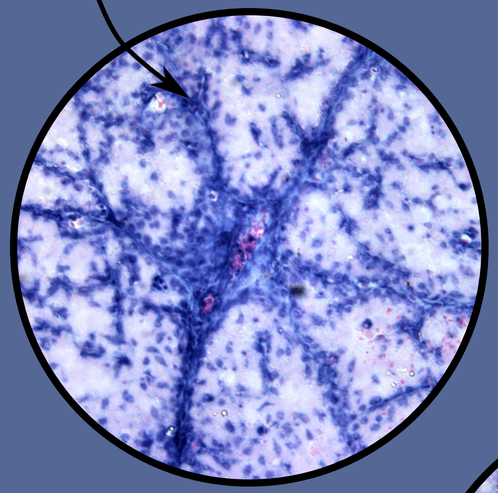


Analysis of fish pictures showed that fish have tumors more frequently behind the head and close to the anus.

This result suggests infections may be linked to feeding.

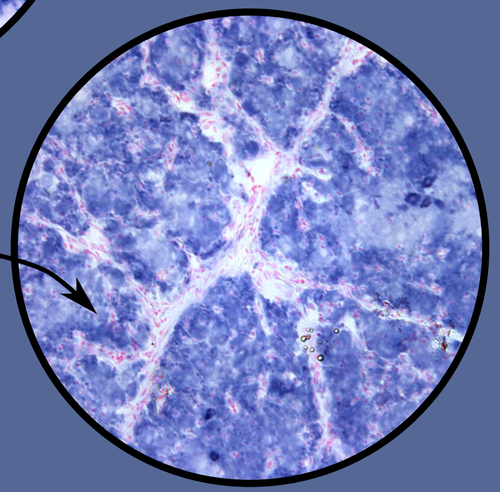


Fish cells are stained in blue here



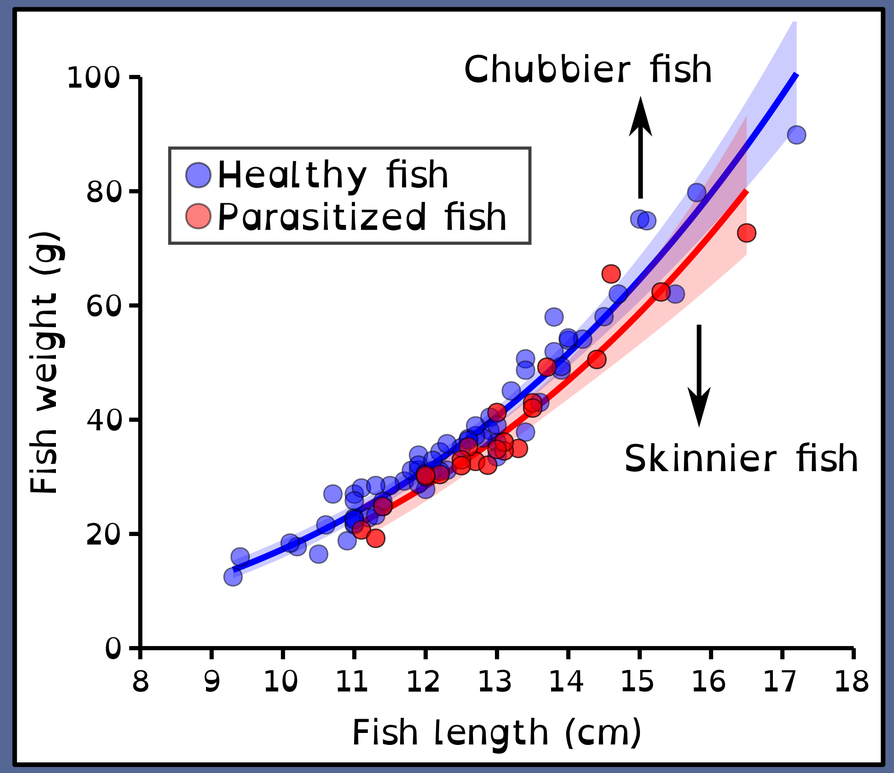
Molecular microscopic techniques that stain blue either fish cells or X-cells revealed that the parasites proliferate within the fish skin and fill large compartments between thin partitions of fish cells.

Results were inverse images of one another!



And here, X-cells are stained in blue

Measurements of fish weight and length showed that parasitized fish are skinnier than healthy fish.



These parasites must really harm the fish!

So why are X-cells now affecting these fish
while no one has seen such an epidemic in Antarctica before?

Are X-cells waking up from a cold sleep
and becoming more infectious?

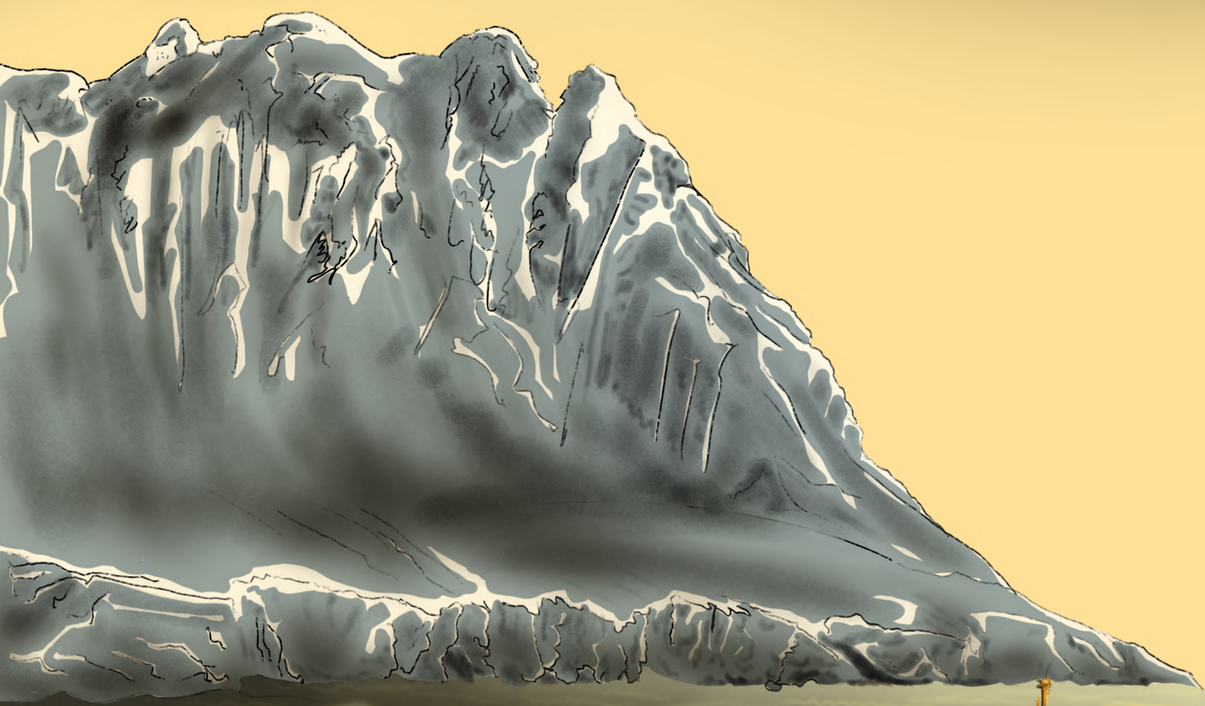
Or are fish getting weaker because of climate
change, making them more likely to get infected?

Maybe both?

Or maybe something else?
There is so much we don't know
about these parasites...

Will this disease spread
to other fish
and other places
in the Southern Ocean?

The scientists are planning to go back and explore additional areas to answer these questions.



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by T. Desvignes, H. Lauridsen, A. Valdivieso, R.S. Fontenele, S Kraberger, K.N. Murray,
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