



The crew of the research vessel *Nathaniel B. Palmer* prepares to deploy a net off the stern of the ship. The net is used to capture silverfish, an important species in the Antarctic food web that appears to be vanishing along parts of the peninsula.

Photo Credit: Erica Hudson

Fishy business

Climate change may be to blame for disappearance of Antarctic silverfish

By Peter Rejcek, *Antarctic Sun* Editor

Posted July 9, 2010

Adélie penguins across parts of the northwestern Antarctic Peninsula don't appear to be getting a balanced diet these days.



What's missing? A sardine-sized fish called *Pleuragramma antarcticum*, more commonly referred to as the Antarctic silverfish.

Once upon a time, as the story goes, Antarctic silverfish swam by the thousands in places like Arthur Harbor at the northern end of the peninsula.

"That doesn't happen anymore," said [Joseph Torres](#), a professor in the [College of Marine Science](#) at the [University of South Florida](#). Torres led a diverse team of biologists, oceanographers, geneticists and others to the region earlier this year to find out exactly what's happened to the silverfish.



Photo Credit: Joel Bellucci

Antarctic silverfish

It's been about 15 years since any significant numbers of silverfish were found in the Adélie diet in the area around Palmer Station on Arthur Harbor, according to Bill Fraser, whose work in the region dates back to the 1970s and is part of the [Palmer Long Term Ecological Research](#) program funded by the [National Science Foundation \(NSF\)](#). The NSF

also funded the silverfish expedition.

The scientists traveled aboard the research vessel [Nathaniel B. Palmer](#), steaming about 1,200 kilometers along the western side of the peninsula, starting south at Charcot Island to the northern tip at Joinville Island, stopping at several key penguin colonies along the way.

"What we wanted to do was contrast the different regions in terms of how many silverfish they had and what the diet of the penguins there was like," Torres explained. "We were curious if the penguin diets reflected what the community was like out there."

Expected results

The scientists used two methods to search for the disappearing silverfish. They towed nets from the ship along the relatively shallow waters of the continental shelf near where penguin colonies forage for food. And Fraser's seabird researchers visited key penguin colonies on various islands. They examined the stomach contents of nearly 60 birds, as well as attached satellite tags on some penguins to monitor their foraging habits.

They found silverfish where they expected to find them — in the south, where sea ice and a colder climate persist. They didn't find them where they expected not to find them — around Palmer Station farther to the north, where ambient winter temperatures are up about 6.5 degrees Celsius since the 1950s and sea ice is a fading memory.

Like other parts of the polar food web — such as Adélie penguins and shrimp-like krill — the silverfish rely on sea ice for parts of their lifecycle. For example, the sea ice offers cover when the eggs hatch in November, Torres noted.

Without it, he added, “the larvae are exposed to predation in the open water.”

Based on the preliminary results of the net tows and diet samples, Fraser said, “I think we can pretty substantially confirm that the silverfish have, in fact, disappeared from a very specific region of the Antarctic Peninsula, which happens to be the region that has experienced the most rapid winter sea ice loss over the last three decades.”



*Photo Credit: Joseph Torres
An Adélie penguin near
Rothera Research Station.*

On the other hand, silverfish still account for a substantial part of the the penguin diet for birds at Charcot and Avian Island to the south. While still awaiting more definitive analysis, Fraser said he estimated that *Pleuragramma* made up about half of the meals for birds on Avian and upwards of 80 percent for the most southerly Adélies at Charcot.

Outclassed

But the story is more complicated — and possibly grimmer — than the scientists first suspected. While they found Antarctic silverfish in the south, they saw fish dominated by only one age class, a cohort they estimate to be about 9 or 10 years old. The absence of a younger age class, a new generation, is worrisome, according to Torres.

“It tells me that the population isn't getting any new recruits,” he said. “What we're looking at is a population that is not a healthy one.”

In fact, the only bright spot was around Joinville Island in the extreme north, where currents from the Weddell Sea bring in new silverfish from the still healthy populations on the eastern side of the peninsula. But thickening sea ice and blustery weather that dropped the wind chill to minus 50 degrees centigrade made for challenging working conditions there.

“The ocean was freezing too fast. We were really limited in terms of what we could do and where we could go,” Fraser said.

1 2 [Next](#)



A tabular iceberg in Antarctic Sound, a body of water at the far northern end of the Antarctic Peninsula, the only place where researchers found a relatively healthy population of silverfish.

Photo Credit: Joseph Torres

Page 2/2 - Posted July 9, 2010

Otoliths

The researchers are keenly interested in figuring out where the Charcot and Avian silverfish populations come from. That job largely falls to [Julian Ashford](#) 🌐, a professor of oceanography at [Old Dominion University](#) 🌐.

Ashford employs a technique called Inductively Coupled Plasma Mass Spectrometry, or ICPMS, that can not only tell him about where the fish were spawned, but what environmental conditions existed from year-to-year during the animal's lifetime. All he and his team need for the analysis is an otolith — a small ear bone.

The otolith is made mainly of calcium carbonate, like corals, which is different than most bones of the body, which are made of calcium phosphate. Juvenile fish lay down new layers of bone every day, while older fish create new layers every year, corresponding to winter and summer. Ashford said scientists can count the rings of an otolith to determine the fish's age, just like a tree ring.

Trace elements found in the calcium matrix, on the other hand, can offer clues to the kind of conditions that existed throughout the critter's lifetime. For example, the chemical element strontium can indicate water temperature.

"What you're getting is a kind of environmental record that's related to chronology, and the fish are constantly putting that down throughout their life history," Ashford said.



Photo Credit: Penguinscience.com

Fish otoliths. The small, rounded ones are from Antarctic silverfish.



Photo Credit: Joseph Torres

The research vessel Nathaniel B. Palmer tied up at the pier of Rothera Research Station off the Antarctic Peninsula.

The researchers can follow the chemical tracers in the otoliths like breadcrumbs, mapping the fish's route through different parts of the water column and different regions. So, for example, separate populations of silverfish that were spawned in different areas will have a different signature from each other.

"They'll be recording water peculiar to their spawning area," Ashford said. "It's terribly important to know what proportion of fish you have in a particular area

is self-recruiting from a local population and how many are migrating in from other populations.”

Common source

Ashford said he suspects the Charcot and Marguerite populations share a common source based on the demographics. The chemistry work from the otoliths will confirm those suspicions.

Previous research has shown that krill are also dominated by certain age classes, likely related to environmental cycles, particularly sea ice.

“It may be that similar events are driving the Pleuragramma,” Ashford noted.

Another team of collaborators from Italy collected tissue samples at the same time Ashford extracted his otolith specimens. The Italians will analyze the silverfish’s genetic characteristics and compare them to other silverfish from around the Southern Ocean, according to Torres.

“We have two lines of evidence being worked up now to see where they came from and who they are most closely related to. That’s a pretty nifty thing,” he said.

The results from the cruise will establish an important baseline for researchers to track the future progress of the Antarctic silverfish along the Antarctic Peninsula, Torres added.

“When this fish is missing from the smorgasbord for penguins and other seabirds, [the predators] tend to decline in numbers,” he said. “The silverfish is the only Antarctic coastal pelagic fish that is accessible to all predators. It is extremely important.”



Photo Credit: Joseph Torres

Fur seals are among the predators that prey on silverfish.

NSF-funded research in this story: Joseph Torres, University of South Florida, [Award No. 0741348](#); Julian Ashford, Old Dominion University, [Award No. 0741362](#); and Bill Fraser, Polar Oceans Research Group, [Award No. 0741351](#).

[Back](#) [1](#) [2](#)