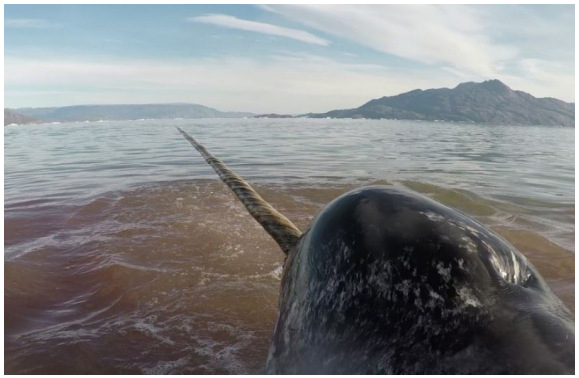
Expedition: Climate Change and the Iconic Narwhal

Investigating adaptive behaviors in remote Scoresby Sund

Summary: The iconic narwhal remains virtually unstudied due to its deep diving habits and polar distribution. Warming oceans, shrinking sea ice and increasing ship traffic in the Arctic habitats of these large, introverted whales are threatening their survival. Wildlife eco-physiologist Dr. Terrie Williams spent a month above the Arctic Circle conducting some of the first thermal measurements for this species with new infrared technology built to investigate their thermoregulation and adaptability amidst environmental change and altered ecosystems.

THE EXPEDITION

The six team members of our expedition met in Akureyri, Iceland, to board a small red- and-white Twin Otter propeller plane chartered for Greenland. The two-and-a-half-hour flight took us across iceberg-studded blue waters and the Arctic Circle, and then deep into the largest fjord system in the world, Greenland's Scoresby Sund.



A narhwal in Scoresby Sund, Greenland

Our camp, located in Hjørnedal at the base of Fønfjord (Windy Fjord), is so isolated that only our research team, a handful of local hunters, the rare tourist sailing ship, and narwhals ever visit this area. Here our team lived for a month in bright orange Scott tents based on the design used by the famous Antarctic explorer, Sir Robert Falcon Scott. Unlike previous years, this would be a short one-month expedition to test instrumentation for a larger multi-month expedition in 2020.

Concerned about the effect of increases in environmental temperatures on the iconic narwhal, we were examining how these deep diving whales are able to maintain stable body temperatures as ocean temperatures rise. Such warming is difficult for this species for two reasons. First, narwhals are designed to be well-insulated. Their body is encased in a fatty blubber layer that can be over four inches thick in some areas. As a result, they need "thermal windows" – areas with no blubber - where excess heat can escape. Second, narwhals have no dorsal fin. A big dorsal fin sticking out of their back would be a problem swimming under dense Arctic ice floes, and constantly scraped when traveling beneath icebergs. In contrast, whales that don't live in ice-covered areas, such as dolphins and killer whales, have large dorsal fins that can be used as a radiator to eliminate excess heat. These fins act much like our hands that become flushed when we become overheated. The mystery we wanted to solve on this expedition: How do narwhals expel excess heat when they become warm if they have no dorsal fin?

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Field Camp Location

We used high-tech infrared heat monitoring cameras to find the answer. Narwhals that came into the shallow areas near our camp were netted by Inuit hunters and then later released back into the wild. Before the release, we took pictures using our infrared camera to determine if there were hot spots that could serve as thermal windows for the narwhal.

WHO

Dr. Terrie M. Williams

WHAT

Measuring thermal profiles and ecological significance of narwhals

WHEN

August - September, 2019

WHERE

Scoresby Sund, East Greenland

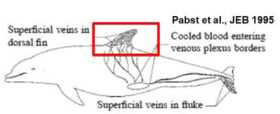
WHY

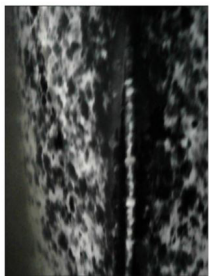
To determine the effects of climate change on the wild narwhals of Greenland

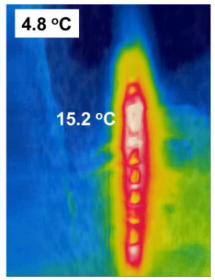
Terrie M. Williams

EXPEDITION GOALS

Our goals were to determine the effects of climate change on Greenland's wild narwhals; examine the thermal profiles of resting narwhals using infrared thermal cameras; identify key thermal windows for heat loss in the narwhal with special attention to the dorsal ridge; and test instrumentation for monitoring thermal balance in free-ranging adult narwhals, including skin temperature monitors and heat flow transducers, for further research in the 2020 field season.







The team's discovery:the middle of a narwhal's back serves as a heat radiator helping it to maintain its body temperature when it is hot. This is very different from the vascularized dorsal fin and tail of dolphins (upper right image)

EXPEDITION FUNDING

Support from Wings WorldQuest provided the thermal cameras; funding for expedition logistics was provided by the Greenland Institute of Natural Resources.

CHALLENGES FACED

This was both a successful and an exceptionally challenging year for working in the Arctic. A heat wave had swept over Europe during the summer, causing many countries to wilt under unprecedented temperatures. Greenland had also experienced a heat wave that was immediately noticeable from our chartered plane as we flew over the glaciers surrounding our campsite. We witnessed the true definition of "glacial collapse" in the dirty brown scars that had replaced the pristine, blue-white ice which used to slide down deep-cut valleys. Icebergs broke off of the ends of the glaciers and threatened our moored boats. Crashing, groaning, and exploding ice unnerved us during the day and woke us up during the night. Climate change had escalated to new heights.

Most worrisome was the shift in timing of animal movements, causing the narwhals and their fishy prey to arrive very late in the season. With the narwhals showing up one to two months later in the summer than usual, their time in Scoresby Sund butted up against the approaching winter and ice-up of the fjords. This year we only had a week with the narwhals before the snows arrived. It made us wonder if there will soon be a time when the narwhals will no longer come into Hjørnedal. Our followup expedition next summer will be the test.

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EXPEDITION RESULTS

We were surprised to discover that the narwhals had a unique thermal window unlike any dolphin or whale that we had ever measured! Instead of losing heat from a tall dorsal fin, the narwhals had converted a ridge along their back into a "hot line" for bypassing their blubber layer. While the insulated parts of their body were as cold as the water, the "hot line" could heat up to over 15 degrees warmer than the surrounding water. This allows the narwhals to dump excess heat when needed, and then turn off to allow the narwhal to conserve heat and thus maintain a mammal's constant warm body temperature. It was a wonderful thermal adaptation that will help this whale to survive some of the climatic changes occurring in the Arctic.

The expedition team in survival suits, working in near-freezing water to measure and release narwhals

ABOUT THE FLAG CARRIER

Terrie Williams is a wildlife eco-physiologist and professor at the University of California - Santa Cruz. In a career spanning more than 40 years, she has studied the energetics, biomechanics, and thermoregulation of big terrestrial and aquatic mammals, including African lions, elephants, narwhals, dolphins, polar bears, otters, and Weddell seals. Her research expeditions seek to identify biological Achilles' heels in endangered species and have taken her to the Arctic, the Antarctic, Africa and California. By examining the relationships between animals and their environment, Williams strives to understand the ecological significance of a species and the physiological adaptations required for survival in a constantly changing world.

EXPEDITION TEAM 2019

Dr. Terrie M. Williams - *American Team*

Danish Team:
Dr. Mads Peter Heide-Jørgensen
Dr. Outi Tervo
Dr. Mikkel Sinding
Dr. Eva Garde
Hans Christian Schmidt

Terrie's home for the month - a Scott tent

WINGS WORLDQUEST

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