A World Under Ice: How Plankton Shapes Life in a Secluded Arctic Village

Nestled against the stark, icy backdrop of Greenland's east coast, one of Earth's most secluded settlements provides a splash of vibrant colours in a world of white: blue, red, green, and orange houses cling to the side of a mountainside, like a painter's palette dropped on snow. This was Ittoqqortoormiit, pronounced it-ockor-tormit, a living testament to the symbiotic relationship between humans and the environment. Here, the sea ice is not just a barrier but a lifeline, a connector to ancestral traditions, and a crucial means for travel and hunting, all sustained by the rich biodiversity under the ice, anchored by plankton.

Scoresby Hamoneken, Chief of Hunters stood at the edge of the village, his eyes fixed on the approaching silhouette of a new state-of-the-art icebreaker - Le Commandant Charcot. The luxury cruise ship, cutting through the thick ice, brought with it a wave of visitors – and a team of scientists – eager to expand their knowledge of life in the remote wilderness of the Arctic.

As the Charcot anchored, Xavier Boymond, a professional photographer and videographer, left the vessel and began walking across the frozen fjord, ice crushing underfoot. Walking beside him, Dr. Tim Boxhammer, the lead scientist on board, was on the lookout for seal holes to get access to the water below. Beneath their feet, separated by thick layers of sea ice, there's a whole world buzzing with life–millions of tiny plankton. Boxhammer and his team were there as part of a five-year strategic Arctic observing programme, running between 2022 to 2026, through the European Union's consortium for Arctic research icebreakers (ARICE), which includes research on a particular type of zooplankton: mesozooplankton.

As important grazers of microalgae in coastal systems, these small planktonic animals (no more than 0.2-2 mm) have the potential to prevent or mitigate harmful algal blooms. They are also a vital part of the food web.

Leaving Boxhammer to his search, Boymond could hear the distant sounds of children playing and dogs barking as he was greeted by Scoresby. "Aluu. Welcome to Ittoqqortoormiit," he said, smiling broadly, his voice deep and resonant. With a friendly handshake, the two made their way into a red-stained wooden house, woolly muskox skins hanging over the porch railing.

Situated over 800 kilometres from its nearest town, Ittoqqortoormiit remains cut off for most of the year, accessible only by the occasional helicopter. A few times a year, different ships would arrive, bringing supplies that help to bolster the community through the long, icy months.

But this isolation has also shaped the village's unique relationship with its environment. The sea ice, which envelops Ittoqqortoormiit for nine months, is more than just a barrier—it's a lifeline. The indigenous people rely on it for travel, for hunting, and as a bridge to their ancestral traditions.

Left: Town of Ittoqqortoormii, east coast of Greenland. Right: Dr Boxhammer descends Underwater Vision Profiler (UVP6) for real-time images of plankton and other particulates during the Arctic GOOD-IMDOS science campaign in June 2023. Photo credit: Xavier Boymond.

"The chief of Hunters taught me the ways of hunting, and this knowledge was passed down to all of us. When my son was four, I began teaching him, taking him hunting by the age of five. Now, he's a skilled hunter," Scoresby says proudly, gesturing for Boymond to take a seat.

Scoresby has been hunting in the region since 1987, observing the unsettling effects of climate change on his community. "Ice formation now starts later in the year, around November or December, and the ice isn't as thick as it used to be. And we've had more westerly winds in winter, so less snowfall and more rain," he adds.

The rhythms of life in this village are inextricably tied to the Arctic ecosystem. The traditional hunting routes, passed down through generations, are being redrawn by the changing patterns of marine life. Hunters can sometimes travel as far as 200 kilometres from the village, depending on the season and the animals' movements.

Governments are now encouraging them to look to a future in fishing, since halibut inhabit local waters. But efforts to find and catch the fish aren't always successful. "We fish for Arctic char, but halibut is unpredictable. We don't know where they are [or understand their life cycles – when they come or when they go]. We search for them, and some years we find them, some not," says Scoresby, worried lines appearing on his forehead. "I hope we find them before I die."

With its intricate web of life, the Arctic ecosystem faces severe threats, primarily due to climate change. The Arctic is warming four times faster than the global average, and the sea ice, which once served as a lifeline for hunting and travel, is now retreating at an alarming rate. Predictions suggest that the Arctic might witness its first ice-free summer as early as the 2030s.

This accelerated warming disrupts the natural balance of marine communities, including a vital ocean dweller: zooplankton.

Powers of Plankton

"I found one" calls Boxhammer, pointing to a large seal hole several metres away. With a member of the crew on the lookout for polar bears, the team unpacks a sophisticated camera called a Underwater Water Vision Profiler (UVP6), which will snap rapid-fire images as it's lowered through the icy hole into the dark water. The images captured will be scrutinised back onboard the ship to identify mesozooplankton varieties, from copepods (minute crustaceans) to worms and jellyfish.

These seemingly insignificant creatures not only sustain the marine food web but also serve as indicators of the health and vitality of the entire ecosystem. Most marine animals, with a few exceptions like whales, sharks, and turtles, start their life cycle as zooplankton – tiny free-floating or weakly swimming animals. As these organisms grow, they evolve into the larger creatures we commonly recognise.

"When plankton flourish, the entire Arctic comes alive," says Dr. Maria Grigoratou, Science Officer for the EU4OceanObs project funded by the European Union. "Given the Arctic's strong seasonality, some plankton species become a potent energy source that sustains life throughout the year. Larger animals, such as whales, eagerly anticipate these blooms, travelling thousands of miles to feed on these species, rich in energy, ensuring their survival and that of their offspring."

As sea conditions change and become warmer, many of these tiny creatures relocate, seeking environments that suit them better. Consequently, marine predators that feed on zooplankton alter their migration routes to follow their prey, resulting in unforeseen policy and regulatory implications. A notable example is the lobster fisheries along the sub-polar North Atlantic coasts of the US and Canada in the Arctic.

This is attributed to a specific plankton species shifting its habitat due to climate change, leading whales into new locations where they expose themselves to human threats like fishing activities. The United States and Canada have implemented different regulations to protect right whales, which have caused disputes and trade implications between the national lobster industries."

This example illustrates how alterations in even a single zooplankton species can signal broader ecological and socioeconomic complexities in the Arctic and polar regions as climate change advances.

The Arctic's Changing Biodiversity

The Arctic sun, ever-present in the summer months, casts a gentle glow over the village of Ittoqqortoormiit. The cold, crisp air filled the lungs as Scoresby and Boymond walked the well-trodden paths between colourful houses and extruding rocks.

Pointing to the shoreline, Scoresby spoke of more changes to local marine life populations, "Maybe 15 or 20 years ago, we see just one or two belugas, but now we see many, maybe 300 or 400 belugas. The same for killer whales; we see them first only a few years ago, but now they come every year."

A glaring indicator of these ecological shifts is the easily spotted drifting sea ice, now visible even via satellite imagery. In a surprising 2012 revelation, bluefin tunas, typically alien to the area, were netted off East Greenland. This, along with unexpected large gatherings of fin and humpback whales in waters once dominated by ice, hinted at a profound change in the subarctic ecosystem. At the same time, high Arctic dwellers like narwhals and walruses started dwindling in Southeast Greenland.

The marked decrease in summer drift ice along East Greenland is fuelling this ecological metamorphosis. One Europe Union project hopes to decipher and project these shifts and their ramifications on two essential marine ecosystem services: fisheries production and carbon sequestration. The former sustains many Arctic communities economically, while the latter is instrumental in shaping global climate patterns. As a premier Horizon 2020 research project, ECOTIP (The Ecological Tipping Cascades in the Arctic Seas) is championing community involvement and partnering closely with Greenland's fishing communities to grasp the societal repercussions of biodiversity and ecosystem shifts and to craft approaches to adapt, counteract, and diminish these effects.

The Need for Monitoring

"Our long-term marine monitoring programmes have unveiled scientific evidence of animals, including plankton, shifting towards the poles due to climate change," explains Grigoratou, an oceanographer passionate about plankton ecology. "As Arctic waters warm, species from regions of lower latitudes like the UK may venture further north. However, there's a catch. Even if the Arctic reaches tropical temperatures, the amount of sunlight won't be the same."

She continues, "The pressing question is: what's the fallout if new species invade? While biodiversity might shift, can the ecosystem maintain its equilibrium? Many experts express doubts. They argue that the Arctic's foundational elements could face severe upheaval from climate change, complicating recovery—especially given the Arctic's distinct seasonal light conditions."

Arctic walrus. East Greenland. Photo credit: Xavier Boymond

Consider the Arctic copepods as an example. These crustacean zooplankton are highly adapted to the brief seasons of the north, where their food source, microalgae, is available for only a few weeks. They can store substantial energy as lipids, making them a rich energy source for predators like Arctic fish larvae. However, if sea ice recedes and waters warm, Atlantic sibling species might invade and displace the Arctic copepods. These invaders, being leaner and less adapted to the short Arctic summers, could lead to a significant reduction in the available energy source for predators.

It's vital to grasp the balance of carbon dioxide between the ocean and atmosphere, explains Grigoratou. "Significant changes in the zooplankton community could impact carbon storage, reverberating in our everyday lives. Studying marine life is intricate. Unlike measuring temperature, which might employ a single instrument, marine life research, including zooplankton, demands diverse tools tailored to the environment, whether it's the Arctic or the Red Sea."

This complexity means that progress in this area might be slower than in others, reflecting challenges faced by the broader international scientific community. In the wake of understanding the Arctic's marine life, particularly the role of zooplankton, global initiatives have risen to the challenge of preserving and understanding our ocean. The G7 Future of the Seas and Ocean Initiative (FSOI) recognised this as a global priority. This initiative unites marine scientists, government representatives, and ministries across the G7 nations, aiming to enhance the global ocean observing system. The G7 FSOI seeks to drive coordinated investments, lead technological endeavours, and foster governance and policy consensus among G7 nations.

In 2023, the G7 FSOI group held a workshop dedicated to plankton, covering both zooplankton (tiny marine animals) and phytoplankton (microscopic marine plants). Grigoratou explains, "Our primary aim was to bridge the gap between direct water observations, satellite data, and predictive models. This would help us get a clearer picture of how marine ecosystems work and refine the tools we use to guide policies, especially those related to vital resources like seafood. Our next big challenge was addressing the issue of data accessibility."

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A study from February 2023 revealed that only around 18 per cent of long-term zooplankton data is openly available. The workshop aimed to tackle this issue, finding ways to increase open access to this crucial data for researchers, policymakers, and the general public.

Grigoratou, who also co-heads the G7 FSOI Coordination Centre at Mercator Ocean International, added, "We need to realise that what happens in the Arctic doesn't just stay there. Its impact is felt far and wide. So, it's vital for people everywhere to stay informed about its changing landscape."

The Arctic, teeming with over 21,000 endemic species, is a testament to nature's diversity. These creatures, honed by the relentless cold, not only sustain life but form an important part of the indigenous people's heritage and traditions. However, this intricate harmony, safeguarded for ages by the Arctic's isolation, is now on thin ice. The encroaching effects of climate change, along with our increasing footprint, signals a turning point that could reshape the Arctic and its people.

"My final message is simple. I cherish my life as a hunter and hope our traditions and way of life endure," Scoresby shares with Boymondas they join the science team to begin the icy tread back to the Charcot. The ever-present sun and the changing patterns of marine life—it all painted a picture of a society deeply rooted in its environment, acutely aware that inevitable change looms on the horizon.

The article was written by Kira Coley, an independent scientific journalist, illustrated with photos by photographer Xavier Boymond as part of a communication campaign to showcase EU commitment to and the importance of Arctic ocean observing and monitoring. Coordinated by the EU4OceanObs team at Mercator Ocean International with funding from the EU, we would like to thank everyone who participated in the campaign, and agreed to be interviewed, photographed, and advise the project along the way – all experts and researchers from the Global Ocean Oxygen Network (GO2NE), the Global Ocean Oxygen Decade (GOOD) initiative, GEOMAR, AWI, the Ponant Science team, the community of IOC UNESCO, the European Commission, H2020 ECOTIP project, G7 FSOI, among many others.

https://www.eu4oceanobs.eu/oceanobserving-awareness/arctic-observing/

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