SCANDINAVIAN REVIEW

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Discoveries From the Depths

Climate Change Research at the Norwegian Polar Institute

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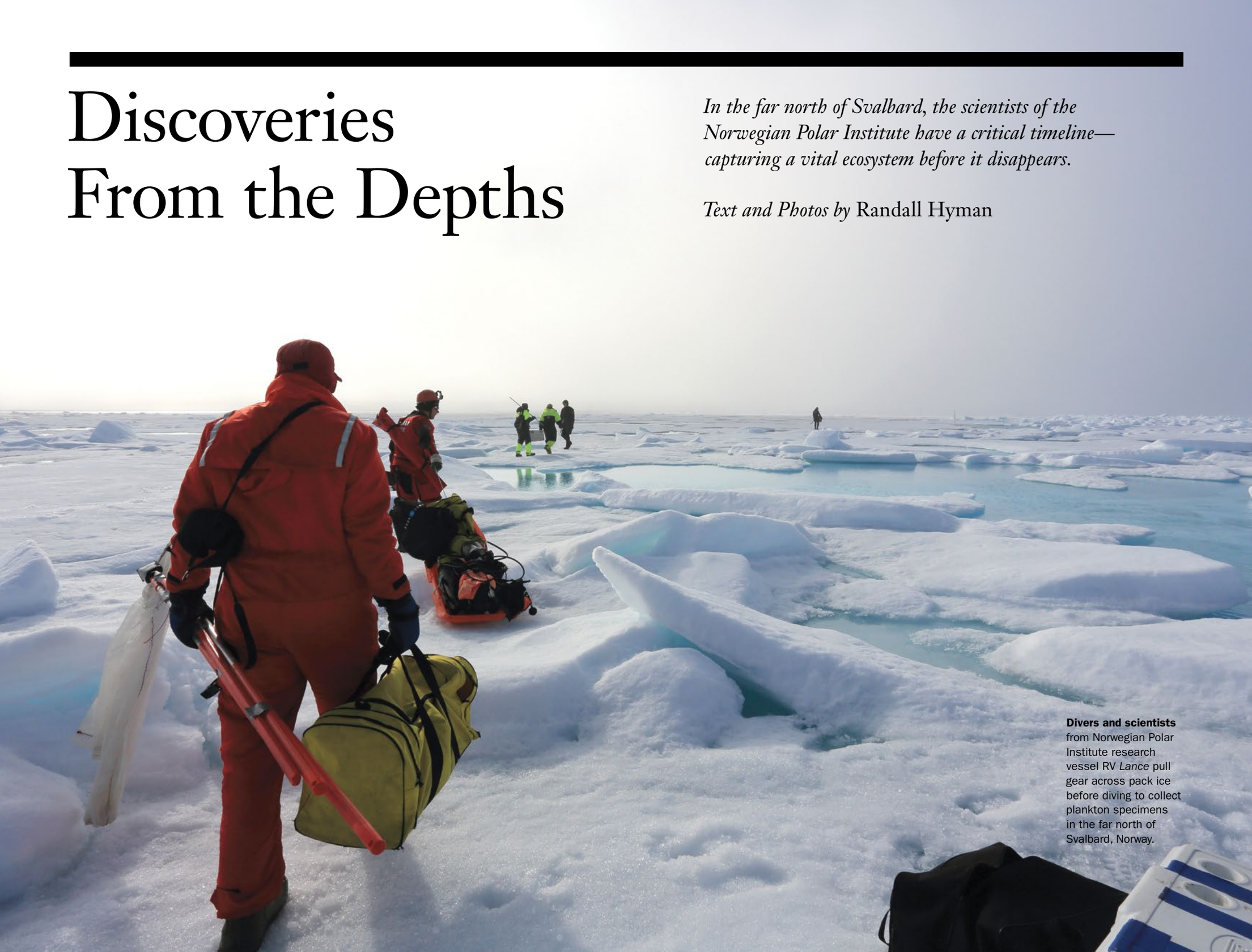
Discoveries From the Depths

In the far north of Svalbard, the scientists of the Norwegian Polar Institute have a critical timeline—capturing a vital ecosystem before it disappears.

Text and Photos by Randall Hyman



Divers and scientists from Norwegian Polar Institute research vessel RV *Lance* pull gear across pack ice before diving to collect plankton specimens in the far north of Svalbard, Norway.

THE ARCTIC IS A harsh place, and as one moves north, the harsher it gets—particularly as one approaches the small Norwegian town of Ny-Ålesund, the most northerly inhabited spot on the Svalbard archipelago before the North Pole. Nestled in Kongsfjorden (popularly called Kings Bay) on the main island of Spitsbergen, what was once an isolated coal-mining town now houses the Arctic's premier research base, a collection of dozens of small buildings, rustic and modern, peopled by 10 nations and hosted by the Norwegian Polar Institute (NPI). Here, where coal was once king, environmental science now rules. And where men once mined fossil fuels, researchers now mine the ocean and atmosphere for clues about climate change.

It is also a location destined to become less and less harsh in the coming years, as its residents well know. Ny-Ålesund scientists have for years raised the alarm about the Arctic's breakneck warming—four times faster than the global average. Over my 15 years of assignments in Kings Bay, I have watched scientists document the results of that warming, as well as its impact on the local wildlife. Among those have been NPI's current head of environmental pollution section, senior research scientist Geir Gabrielsen, who on my first visit to Kings Bay in 2008 took me for a tour of the pristine glaciers along the fjord's inner bay.

"It will be very different for our children and their grandchildren," he said as he nosed our rubber skiff through countless ice floes bobbing in the aftermath of a collapsed glacial wall. "We see all this beauty, but they will not. When you come back in 20 years, it will be very different—maybe some new species, others gone."

Gabrielsen warned then that more than climate change was afoot. Woven into the planet's web of shifting currents and rising temperatures, he said, was another insidious threat. "There

House-sized blocks of ice fly in all directions as a 200-foot-tall wall collapses into the sea from Kronebreen glacier on Spitsbergen island in Kings Bay.

are no borders for pollution, just like there are no borders for increasing temperatures, and the Arctic has become a kind of sink [basin] for pollutants," he explained, gliding through a floating jigsaw puzzle of shattered glacier. "The temperature rise here is twice as high as farther south, and with longer periods of southerly winds we expect pollution will increase."

Over my series of visits to Ny-Ålesund in the following years, Gabrielsen's words increasingly felt prophetic. But they also emphasized the importance of his work and that of his contemporaries. As conditions have swiftly changed within the Arctic, there has been very limited time available to study the resulting changes within its ecosystems and document those before they change again—or disappear altogether. For the NPI scientists, Arctic research has a critical timeline.

ILL WINDS BLOWING

ALONG WITH PLASTICS, PREVAILING wind patterns and ocean currents transport industrial toxins to the Arctic on a one-way trip. In winter, frigid temperatures precipitate toxins from the air and sprinkle them across land and sea. In summer, 24-hour sunlight traps airborne mercury from distant coal power plants in a photochemical reaction with saltwater. The whole cocktail enters the food chain through tiny phytoplankton, traveling all the way up to polar bears.

The best way to monitor these toxins is by tapping into one of the largest biomasses in the Arctic: seabirds. Thousands nest in the ocean cliffs bordering these glaciers. To conduct their research, scientists from the NPI clamber along precipices amid the deafening caws of thick-billed murres and kittiwakes, drawing blood samples from birds nesting along the narrow ledges.

"That made my heart start!" biologist Erlend Lorentzen exclaimed when I joined one team in 2008, after having tripped and nearly careened over a 300-foot ledge. He carried a long pole with a fishline lasso on the end and a white cotton bag with two webbed feet sticking out; this bird, like those gathered by his

Biologist Erlend Lorentzen helps a colleague snare a thick-billed murre from a breeding colony on the Ossian Sars cliffs (top).

Perched atop the sheer cliffs of Ossian Sars Nature Reserve, NPI field tech Delphin Ruche snags a Brünnich's guillemot—also known as a thick-billed murre—from a ledge-nesting colony, using a nylon noose on a pole (left).

Biologist Erlend Lorentzen weighs the seabird he has just snared and bagged from a breeding colony at Ossian Sars.

Scientists examine a thick-billed murre for ticks that have increasingly plagued breeding colonies due to Arctic warming. The bird will quickly be released and returned to its colony.

Having completed their sampling work, NPI field techs Delphin Ruche and Saga Svavarsdóttir release a seabird to its nesting colony on the cliffs of Kings Bay.

Soley Hyman and Dutch biologist Maarten Loonen shepherd barnacle goose hatchlings for an immunological study at Ny-Ålesund (top).

Graduate student Margje de Jong studies the impact of dietary stress on the immune systems of barnacle goose chicks that her science team adopted at Ny-Ålesund (bottom).

three colleagues, would be sampled and harmlessly released to rejoin its mate in less than five minutes. The results, however, were grim—the samples provided ample evidence that increased toxins were linked to declining avian health.

Back at the science village on my same visit, another scientist was studying barnacle geese. Dutch biologist Maarten Loonen made daily rounds with 16 fuzzy goslings earnestly scrambling behind him to keep up with his size-14 wooden clogs.

"They think I'm their mother," he explained, settling among them in a grassy field. Hatchlings latch onto whoever provides care during their first five days of life, so they had elected Loonen as Mother Goose ever since he gathered them as one-day-olds. Raising so many geese in semi-wild conditions, Loonen was able to take weekly blood samples from the same individuals throughout summer.

"We want to track how their systems develop and test the blood for pathogens," he explained, keeping watch for a hungry Arctic fox lurking nearby. "We believe that over here there are no diseases, so the geese invest in growth, not immune systems."

ALONG WITH TOXINS AND WARMING temperatures, Arctic ground-nesting birds face another challenge: polar bears. On a later trip as a Fulbrighter in 2013, I joined biologists studying eider duck colonies on the islands that dot Kings Bay.

Børge Moe had recently watched in dismay as a polar bear swam ashore and plundered all of his study nests. Now the site was a trampled mess of feathers, eggshells and crushed ducklings. "We are becoming more like bear scientists, and less like bird scientists," he told me. Without sea ice for hunting seals, some bears resort to seabird eggs. Such predation has been happening for years at sites elsewhere along the Svalbard and Greenland coasts.

One scientist watched a lifetime study gobbled up in a few short seasons, discovering that a hungry bear can raid 50 nests in just 90 minutes, consuming 200 eggs. After a good nap, they are back on the prowl in half a day. Bears can live without food for six months, but they eventually need seal blubber to survive—omelets are a paltry substitute.

A polar bear mom looks for her two cubs on the sea ice far north of Svalbard (top).

Biologist Børge Moe counts eider duck eggs about to hatch during nest inventory on the small island of Storholmen in Kings Bay (bottom).

A six-year-old male polar bear rests after being sedated in Wahlenbergfjorden at Nordaustlandet, Svalbard (top).

Scientists Jon Aars and Magnus Andersen collect data and samples from the now-calmed bear (bottom).

Though polar bears are clever and fierce, their lives can be harsh.

TRAVELING UP THE FOOD CHAIN

DURING A 2015 WINTER TRIP FROM Kings Bay aboard the Norwegian Coast Guard icebreaker *Svalbard*, I met NPI bear specialist Jon Aars tracking the animals by helicopter and sedating them with darts for sampling and tagging. One, a six-year-old male boar, conveniently chose to hunt within sight of our ship, waiting beside a breathing hole for a seal dinner to surface. Aars had already sedated it when I caught up, zipping across the frozen fjord by snowmobile.

I found the bear lying flat on its stomach, and I did likewise, snapping pictures with its wet nose just inches from my own. It seemed alert, occasionally blinking and trying to make sense of the scene.

The bear's fur looked soft and plush, but with a quick brush of my hand I discovered it was coarse and bristly. Though polar bears are clever and fierce, their lives can be short and harsh, no more than 25 years on average. Survival is fraught with hunger and brutal fights, occasionally leaving a blind eye.

I helped Aars collect a plug of fat from the bear's rump, a necessary indignity for determining its diet. Ringed and bearded seals, its two favorite meals, have very different fatty acids that can be readily identified in the lab. Both hunt from ice and look for areas where fish and seafloor prey are most plentiful. That often translates to ice along shore, but in Svalbard that habitat is disappearing.

"Modeling predicts faster changes coming," Aars said, "so it could be very difficult to be a polar bear here. We have always had variability. The difference now is we're having more bad ice years than good years."

CHASING THE ICE

ICE ALGAE THRIVE IN THE CAVITIES LEFT BY FREEZING saltwater and are a keystone of the Arctic food chain. Beneath thousands of square miles of ice, these tiny marine organisms bloom and nourish the zooplankton consumed by birds and fish; being plants, they also capture vast quantities of carbon dioxide, a greenhouse gas associated with global warming, and help replenish the Earth's oxygen.

On my 2013 visit to Kings Bay, I first saw how dire conditions were becoming when I joined the NPI team on the research ship *Lance*, where we spent days looking for the polar ice pack before pushing to within 600 miles of the North Pole. It was the farthest north any of the scientists had ever needed to venture to find pack ice.

After a week of fruitless searching, we finally reached the vast polar cap, where scientists dragged sleds filled with scuba gear across the snow to dive under the ice. Standing two and a half miles above the ocean floor, one scientist sawed open a breathing hole left by a seal. This would be our trip's last chance to find the ice algae, which flourishes each summer with the return of 24-hour sunlight.

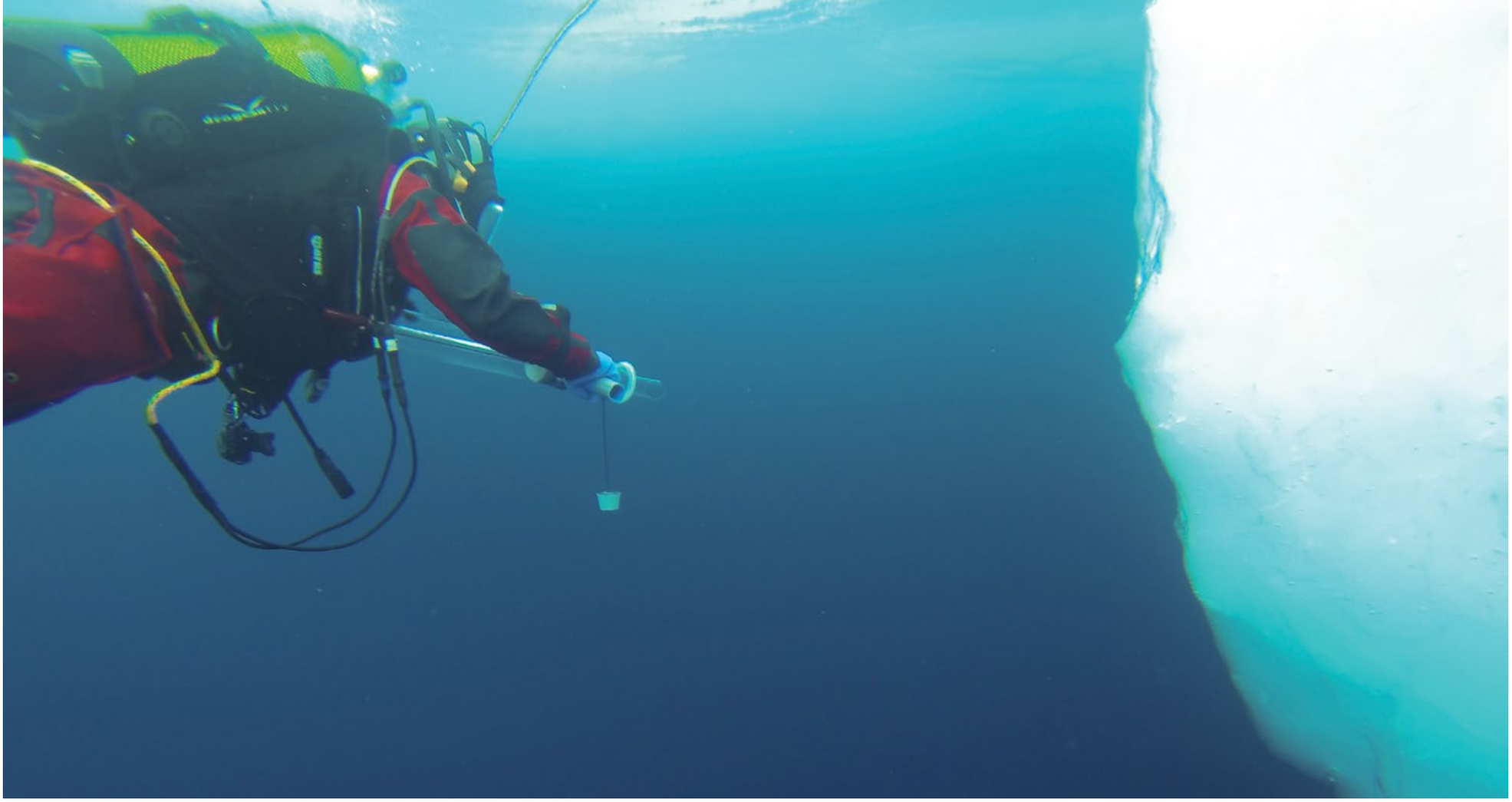
A few days earlier, gazing at empty seas, marine biologist Rupert Krapp had expressed frustration at our many failed attempts, recalling something a colleague once wrote about disappearing sea ice. "He said that people like me might be out of a job in the next 15 years if this continues," Krapp remembered. "He just meant it as a joke, but maybe he was right." Now, eager to get to work, Krapp strapped on his scuba gear and slid through the seal hole into frigid seas, several degrees colder than freshwater ice. When he finally surfaced, he pumped a fist in joy: he had finally found the tiny life that kickstarts the Arctic food web. On this trip, at least, our mission was a success.

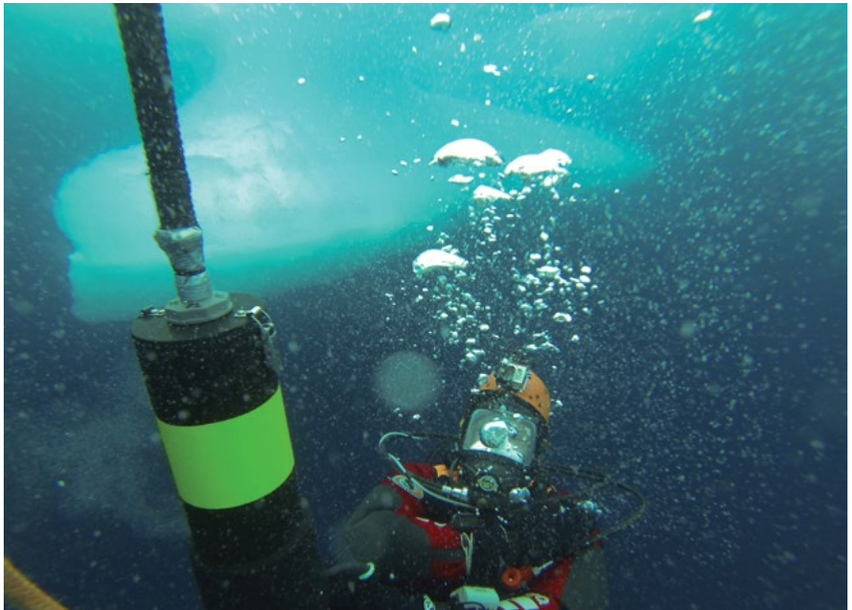
A diver drags equipment from a research ship across pack ice.

Divers from the NPI's RV *Lance* cut a hole in pack ice in preparation for a dive.

NPI research engineer Rupert Krapp wears a mantle of ice after diving to find plankton under pack ice in the far north of Svalbard (left).

Rupert Krapp pumps his fists in victory after surfacing with plankton samples (bottom).





An NPI diver uses a suction device to collect zooplankton samples beneath pack ice at 82 degrees north latitude on an expedition from Svalbard.

A searchlight frames a hovering quadcopter as it photographs the RV *Helmer Hanssen*'s illumination footprint during a research cruise in Kings Bay.

Searchlights of the RV *Helmer Hanssen* cut through winter darkness during polar night in January on a marine science expedition in Kings Bay.

DISAPPEARING ACT

WHILE SUMMER'S 24-HOUR sunlight is critical to life in the Arctic, winter's endless dark, known as the polar night, is equally vital.

Scientists had once assumed that zooplankton—and the entire marine system—hibernate throughout winter in the absence of photosynthesizing algae, a main food. But in 2007, Jørgen Berge, a biologist at UiT The Arctic University of Norway, discovered the opposite. Acoustic instruments Berge had moored beneath ice throughout winter detected teeming life, a cloud of marine biomass, instinctively moving from brighter surface waters to the refuge of the deep at midday—even though there was no perceptible daylight. The discovery upended the world of polar marine biology.

"It was an accident, a complete surprise," recalled Berge later.

Nearly every January since that remarkable discovery, Berge has been leading expeditions to Kings Bay. His team has found that many zooplankton survive winter on their own fat stores, without food, mating and incubating eggs in the polar night.

I first joined his team aboard the research ship *Helmer Hanssen* in 2016. Then, researchers were focused on measuring the light sensitivity of these dark-evolved creatures—they had determined that krill eyes are many orders of magnitude more sensitive than our own. But they soon faced another conundrum: their data did not match the strong biomass rhythms that Berge had originally discovered.

They eventually realized that, while striving to study zooplankton in the pristine polar night, they were removing the "pristine" part by working from a ship full of bright lights. And so they then began comparing the impact of intrusive ship lights against the natural darkness of the polar night by running collection sweeps of Kings Bay with lights on, followed by lights out.

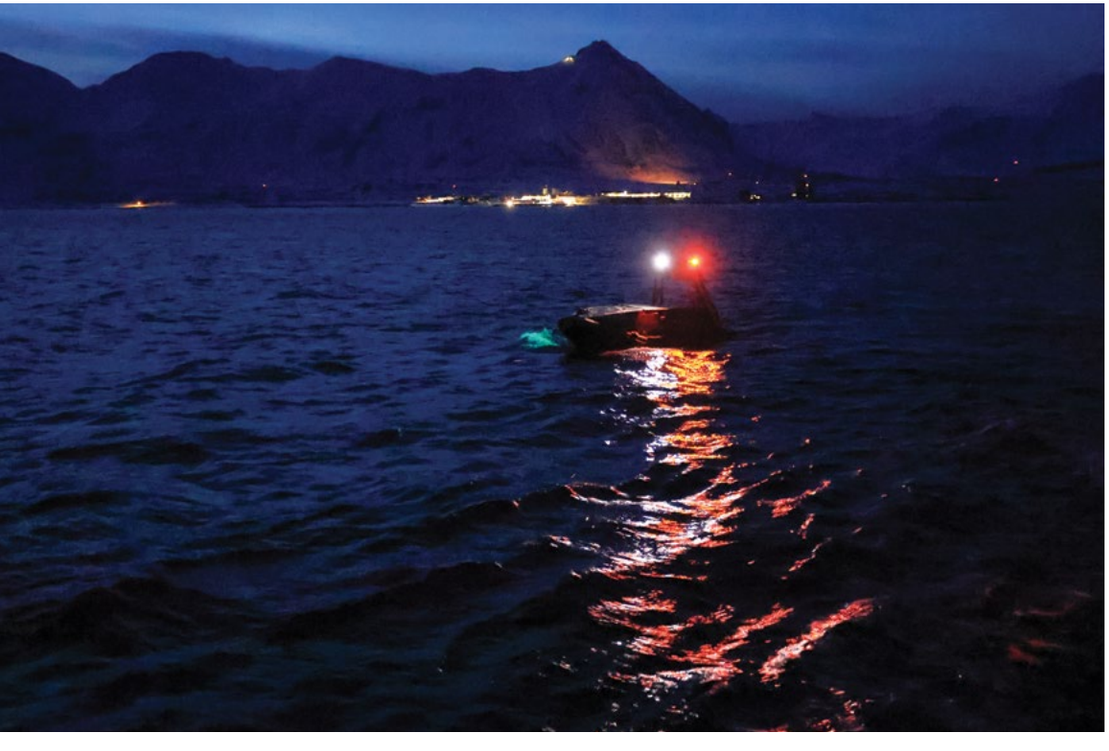
By the time I rejoined the team seven years later in January 2023, their job was simply to

Many zooplankton survive winter on their own fat stores, without food.

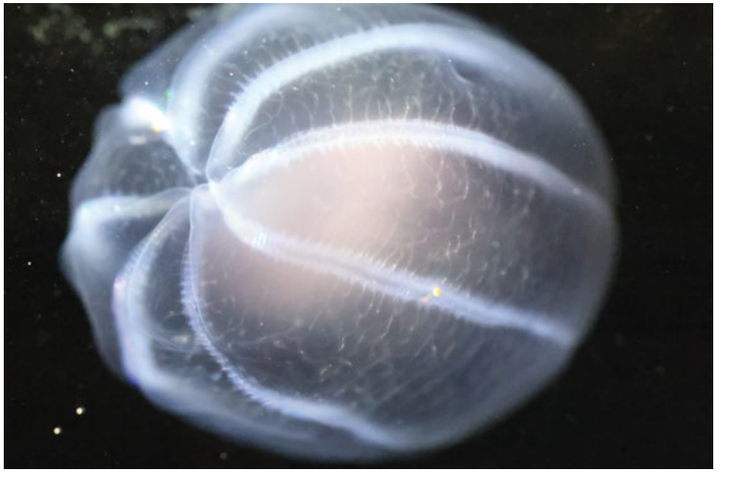
disappear. Each time our captain shut down the ship's glaring deck lights, we became virtually invisible, a maritime phantom.

It was the ideal way to study marine organisms that exploit darkness and cold as few others can. Toward this end, the team was deploying a variety of new instruments, including sonar mounted on unmanned surfaces and submersible craft for monitoring biomass movements without using light.

WITH THESE LESS DISRUPTIVE APPROACHES, researchers were capturing a more realistic view of the natural behavior of light-sensitive marine creatures. Like ice algae, this biomass plays a vital role in kickstarting the Arctic's massive explosion of rebirth each year.



An unmanned surface vehicle (USV) called the *Apherusa* explores the waters of Kings Bay during polar night in the Svalbard archipelago.



Images of an iridescent ctenophore, also known as a comb jelly (top and center) and a pea-sized sea angel or Clione limacina (bottom), both captured in a marine lab at Ny-Ålesund.

An aurora borealis lights the skies above the Ny-Ålesund science village during polar night of mid-January.

"Organisms seek darkness as a refuge," Berge told me. In his view, darkness is as vital an ecological resource as light, and he worries that increased light in the polar night will impact fragile ecosystems. With vanishing sea ice, human incursions from fishing, shipping, seabed mining and oil drilling are increasing, all of which will disrupt that darkness.

ONE QUIET WINDLESS NIGHT, WHILE SCIENTISTS worked to deploy nets under the ghostly glow of red bulbs, I stood alone on *Helmer Hanssen*'s darkened deck admiring the northern lights. Shimmering sheets of emerald and lavender danced above the faintly illuminated snowy mountains of Kings Bay and distant lights of Ny-Ålesund. Just a handful of researchers were at work in the village, but with the return of spring, scores would soon be returning to understand rapidly changing ecosystems in the Arctic.

I recalled Gabrielsen's premonition some 15 years earlier when I first cruised with him past melting glacial precipices. Here, where warming is four times the world average, this remote Norwegian outpost has provided scientists with a front-row seat on events impacting the entire globe. It has also given them a rare window into the beauty and mystery that surround them, both above and below the ice. For now, these abound—but how long that window will remain open is precariously unclear.

Randall Hyman has covered nature, science and culture worldwide for over four decades and is a frequent *Scandinavian Review* contributor. As a 2013 Fulbright Scholar in Norway and guest of the Norwegian Polar Institute, he has covered field science, resource development and climate change in the Arctic for a number of organizations and publications.