Arctic POISON

Melting sea ice is not the only threat to life in the Far North

Story and photos by Randall Hyman

As we float in a glassy fjord off the western coast of Norway's Svalbard archipelago, 770 miles from the North Pole, the Arctic seems pristine, frozen in time. Terns and fulmars quietly swoop and settle atop ice floes and bergs, but the calm is deceptive.

Suddenly, the world sounds like it is cracking in two.

An explosive clap followed by thunderous rumbling ricochets across the fjord. Massive chunks of glacier plummet into the sea a quarter mile away, scattering waves and seabirds in all directions. The spectacle is thrilling but its message is chilling: The Arctic itself is shattering. With record sea-ice lows the past two years and a 23-percent plummet since the previous record in 2005, climate scientists say the Arctic is on track to be completely ice-free for parts of the year by 2030.

"It will be very different for our children and their grandchildren," reflects zoophysiologist Geir Wing Gabrielsen, as he noses our rubber skiff through a galaxy of ice floes still bobbing in the aftermath of the avalanche. "We will see all this beauty, but will they? When you come back in twenty years, there will be big changes, maybe some new species, others gone."

Cruising to another fjord, where he usually finds bearded seals, Gabrielsen is astonished. The inlet is impenetrable, utterly clogged with ice. "Two days ago I could go right in, all the way to the glacier," he remarks. "A lot has been happening for it to change so quickly."

As glaciers calve and retreat, Gabrielsen sees much more than global climate change. He sees poison. Woven into the planet's web of shifting currents and rising temperatures is an insidious cancer that grabs few headlines: the polluting of the Arctic with mercury and a new array of PCB (polychlorinated biphenyl)-like chemicals.

"There are no borders for pollution, just like there are no borders for increasing temperatures," says Gabrielsen, an ecotoxicology professor at the Norwegian Polar Institute. He has spent the past 27 summers in Svalbard, where the institute maintains a year-round presence at an international Arctic research station in the former coal-mining village Ny-Ålesund.

"The Arctic has become a kind of sink for pollutants," Gabrielsen explains, as he zips open his bright orange ocean survival suit and scans the ice for sunbathing seals. Nudging and bumping our boat through the floating jigsaw puzzle of shattered glacier, he worries aloud. "The temperature rise here is twice as high as farther south, and with longer periods of southerly winds we expect pollution will increase."

Over the past decade, Gabrielsen and his colleagues have documented the alarming onslaught of industrial toxins on Arctic species. That toxins exist at all in this remote, industry-free environment is surprising, but prevailing winds and ocean currents transport pollutants on a one-way conveyor belt from western Europe, Russia, and North America directly to the Arctic.

Frigid temperatures capture airborne toxins as precipitates. These particles settle into sediment and soil and ice. In cases of pollution from power plants, intense, high-latitude sunlight binds mercury with sea salt. Other agricultural and industrial chemicals arrive by ocean currents, with the whole cocktail entering the food chain via phytoplankton.

Some of industry's most dangerous toxins, called "persistent organic pollutants" (POPs), take centuries or even millennia to degrade because they are not water soluble. They are, instead, lipid soluble, easily absorbed by animal fat, eggs, and breast milk. If the fat is tainted, the milk and eggs are, too, concentrating poisons more and more with each new generation.

"For Arctic animals," Gabrielsen explains, "fat is vital. It supplies energy and insulation to get through the cold winter. When animals tap these reserves, stored toxins are released. Since eggs and breast milk have a lot of fat, this impacts the young."

Worsening matters, food chain dynamics exponentially multiply trace amounts of POPs as they pass up the ladder—from phytoplankton to zooplankton to fish to seabirds to top predators such as seals, polar bears, and humans. These include older toxins like PCBs and DDT plus their newer cousins, the brominated fire retardants (PBDEs) used in computers and the perfluorinated compounds used in Teflon manufacturing.

Industry has developed some 100,000 new chemicals in the past hundred years, but only 12 are regulated by the Stockholm Convention, an international treaty meant to curb global pollution. Meanwhile, polar bears, Arctic foxes, belugas, orcas, and seals have become among the most toxin-tainted species on the planet.

"You come here and it looks so clean and nice, but when there is a forest fire in Europe, we see the results at our meteorological station a few days later," Gabrielsen adds as he spots a distant seal hidden among the ice floes.

House-size blocks of ancient ice crash into the Arctic Ocean (pages 36–37) from fast-melting Kongsvegen Glacier in Norway's Svalbard. Shattered remnants form a glassy surface on the sea (opposite). Warm winds of climate change also transport invisible toxins from industrialized countries. Zoophysiologist Geir Gabrielsen (above) has chronicled the process during 27 years of research. Predators higher on the food chain, like this young bearded seal (below), amass greater toxins.

"So if there are PCBs in the soil there, they incinerate and end up here."

When scientists first detected PCBs and DDT in the fat of Canadian seals in the 1970s, they were shocked the poisons had infiltrated these remote species. The same toxins were found in Inuit breast milk a decade later, and the numbers tipped the scales as the highest levels of any human population on Earth.

After the alarming discoveries of mixed genitalia among Svalbard polar bears—likely caused by PCBs and the cocktails of POPs in their systems—and an increase of infectious diseases among Canadian Inuits, some scientists are looking to Arctic seabirds as canaries in a coal mine. Their biomass outweighs those of most marine mammals, and their small bodies make them sensitive to pollutants. Best of all, they are as accessible as they are plentiful. Accessible, that is, unless you suffer from vertigo.

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"That made my heart start!" biologist Erlend Lorentzen exclaims as he bounds up a steep slope that disappears abruptly behind him over the edge of a 300-foot ocean cliff. He wears a contagious grin, and in one hand carries a pole tipped with a lasso of fishing line; in the other, he swings a white cotton bag that contains a murre, a seabird in the alcid (auk) family that uses its short, stubby wings to swim underwater to find fish and invertebrate prey.

"I was just catching it, backing up, and my foot stuck in a rock hole. I had to jump—and it didn't feel very good!" Small wonder. One misstep and he would have gone flying with the birds to the colony below.

Serenaded by the constant crying and complaining of thousands of thick-billed murres and kittiwakes, Lorentzen and three colleagues kneel at a field lab they have set up on the precipitous, hummock-riddled slope. They draw a blood sample from the murre's wing, one of a dozen they will take from individual birds this day, and release the dazed volunteer back to its nesting mate perched somewhere on the narrow ledges below.

The cacophony lulls for a moment as hundreds of seabirds wheel through the salty sea mist and icy breeze, coming and going in a dizzying pandemonium. The sweet, pungent odor of guano fills the air, and there is no other place these scientists would rather be.

"For six weeks, I get to be out here," Lorentzen says. "The rest of the year I'm at a desk." During the dark winter, he will pore over data and photographs on a computer. Digital cameras in waterproof cases perched along the cliff take pictures once an hour in the nesting season. By studying the photos for positions of nesting pairs and visible chicks, Lorentzen will estimate the colony's breeding success.

Seabird research can be as expensive as it is tedious. Blood sampling and colony counts help scientists monitor population health, but testing each vial for older POPs costs $1,000, while the analysis for newer toxins runs $3,000. Today's bill will run at least $12,000 and as much as $36,000.

Other seabird research includes captive gull rearing, kittiwake GPS tracking, eider duck censusing, barnacle goose blood sampling, and even tick collecting and incubating. Slowly scientists are connecting the dots, linking declines in avian health with climate change and toxins.

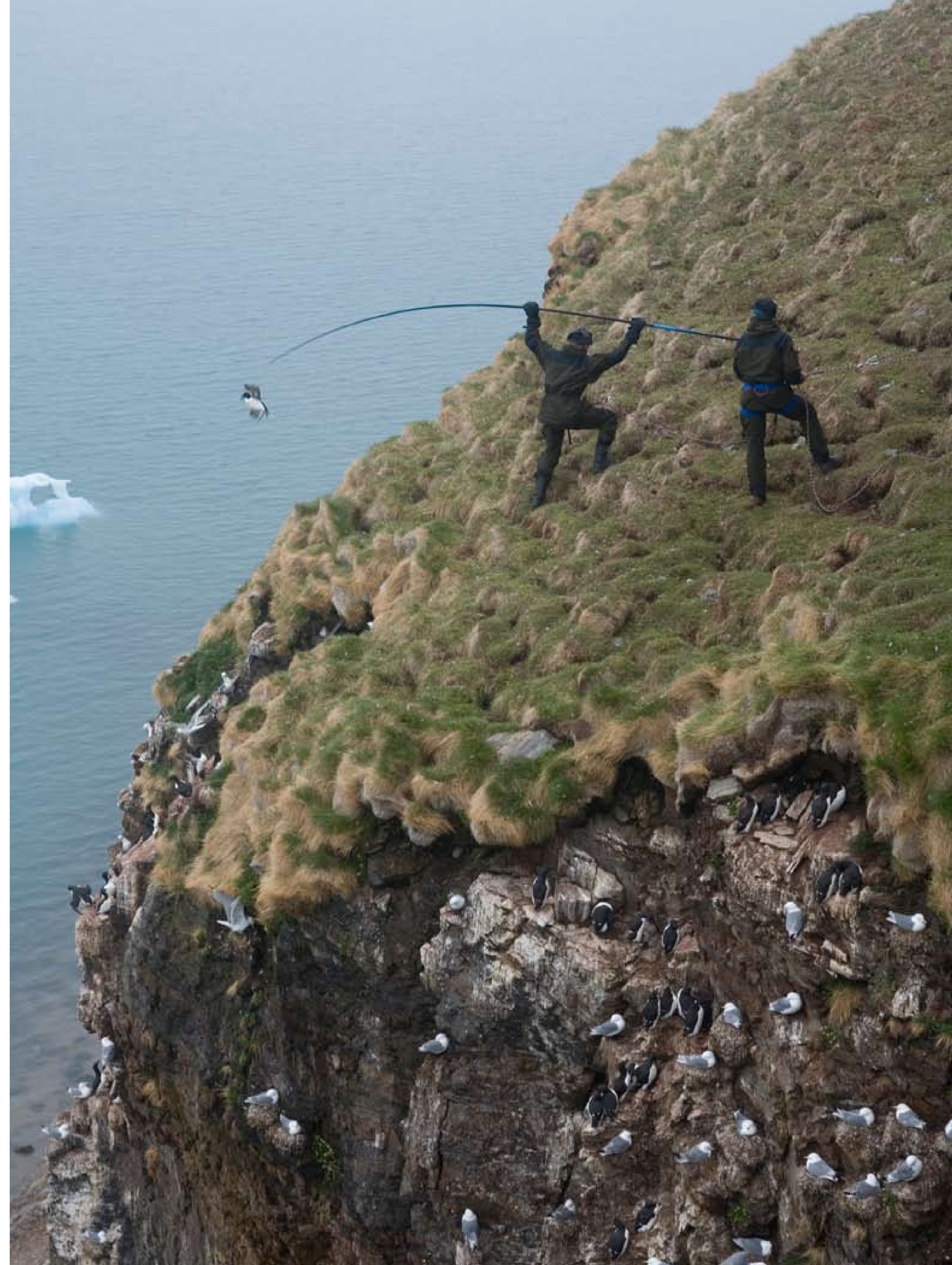
"Erlend found the first ticks on an island southwest of here," says Steve Coulson, a British terrestrial ecologist and entomologist with the University Centre (UNIS) based in Svalbard's main town, Longyearbyen. As he carefully picks through the feathers of another murre that Lorentzen holds, he spots a large gray tick lodged in its skin. "Ticks had never been seen this far north."

Days after Lorentzen spotted the first one on the ground in 2007, other field workers started finding ticks on birds, culminating with the grisly discovery of a dead murre completely covered with them. In the past year, ticks have spread even farther north.

Coulson plucks the tick from the bird, making sure it is still intact and alive, and drops the parasite into a specimen vial. He will incubate this tick and dozens of others at various subfreezing temperatures throughout the winter to determine how much cold they can withstand.

"It's really quite amazing that invertebrates can survive being frozen in the ground ten months of the year and then go through the rest of their life cycle in two months," Coulson marvels.

"Mites on Svalbard can take five years to go from egg to adult, developing one stage each short, two-month summer. Some people are shocked to learn that we have insects at all, some 260 species." New discoveries like these ticks from warmer climes indicate that the tally sheet is in flux, threat-



Balanced atop a 300-foot-high cliff, biologist Erlend Lorentzen hoists a thick-billed murre he has snagged from a ledge below with a snare on a long pole. Thousands of murres and kittiwakes breed here each summer, but toxins and climate change threaten their future. These seabirds help scientists detect environmental dangers. After drawing blood, Lorentzen releases this volunteer and sends the sample to the mainland to test for poisons.

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ening Arctic species that are ill-equipped to weather new pressures.

Snagging a kittiwake from a low cliff on the other side of the fjord, biologist Borge Moe sees climate change endangering seabirds in another way. By tagging kittiwakes with lightweight GPS recording chips before and during the critical nesting season, he studies shifts in seabird feeding patterns. His data show that kittiwakes will fly as far as 180 miles—halfway to Greenland—for a meal.

Climate change could eventually put the birds out of sync with the spring algal bloom and fish hatch. This would affect how far they must fly for food, how often mating pairs alternate incubation, and how successfully they rear their chicks.

“Hormones signal when to start breeding, but the climate is changing,” reflects Moe as he colors the bird’s head bright blue with washable marker. He lofts the bird toward the sea, knowing he must recover the GPS chip from this creature before its punk hairstyle washes off in a few days.

“Some species breed earlier, some later. It is a difficult picture, and the question is whether the birds will adapt.”

Ultimately, the double punch of climate change and toxins may be more than some species can handle. The plump zooplankton *Calanus glacialis* is the prime food of another seabird, the little auk. *Glacialis* depends on the early spring release of ice-entombed algae. With the circumpolar shelf ice in retreat, its warmer-weather cousin *C. finnmarchicus* is moving ever northward and *glacialis* is disappearing. Little auks could suffer dramatically, wasting precious energy hunting the much tinier, less fatty *finnmarchicus*.

“We think that animals in the Arctic are more sensitive,” Moe explains, as we hike later that day across a windswept isle in the middle of the fjord to count eider duck nests and eggs. “They may have immune systems that are less advanced and more vulnerable to parasites, disease, and contaminants.”

Monitoring seabird breeding success, biologist Borge Moe and an assistant gently count eider eggs in a downy nest while a vigilant mother waits nearby. Eggs are particularly vulnerable to lipid-soluble toxins that are rapidly accumulating in the Arctic.

To test this theory, Dutch biologist Maarten Loonen has turned into Mother Goose. In the tradition of famed ethologist Konrad Lorenz, he walks around the international research village with 16 fuzzy goslings earnestly scurrying to keep up with his size 14 wooden clogs.

“They think I am their mother,” Loonen says with a smile, as he lowers his towering frame to their level. Like lovers under a Puckian spell in a Shakespeare play, goslings imprint on whomever acts like mom during their first five days of life.

“*Kom, kom, kom*,” he beckons, keeping a sharp eye out for the Arctic fox and her seven kits that live beneath the wooden floorboards of the Dutch research station.

Loonen collected these barnacle geese as one-day-olds, and now they follow him and his assistants wherever they go. By having so many geese raised in semi-wild conditions close at hand, Loonen can take weekly blood samples from the same birds throughout the summer.

“We want to track how their systems develop and test the blood for pathogens,” he says. “We believe that over here there are no diseases, so they invest in growth, not immune systems.”

To calibrate the hormonal and immunological effects of specific levels of toxins on seabirds, another team under Gabrielsen’s supervision is rearing 40 fulmars and herring gulls on clean versus tainted diets. Ironically, the team obtains ingredients for this tainted diet from Norway’s largest producer of cod liver oil.

“As a kid I used to drink a spoonful of cod liver oil every morning, that same brand,” Gabrielsen remarks. “We kept a big bottle of it in our house to keep everyone healthy.”

These days, to make the oil safe for human consumption, the company must first filter out poisons that cod absorb from the food chain. The concoction is full of POPs and mercury.

Though the ban on PCBs and DDT in the 1970s resulted in a decrease of such toxins in Arctic species, newer POPs have taken their place, and their rate of increase far outstrips the old toxins. Flame retardant PBDEs, used in computers and furniture foam, are fast becoming “the PCBs of the twenty-first century,” with neurological and hormonal effects similar to their predecessors.

Gabrielsen sees promise in the European Union’s new, proactive REACH (Registration, Evaluation and Authorization of Chemicals) regime, which requires industries to prove their chemicals do not travel long distances, do not persist in nature, do not accumulate up the food chain, and do not have biological effects. Still, the United States has been slow to follow Europe’s lead, and Asia is steadily increasing its output of unscrubbed power plant emissions.

“REACH makes industry more responsible, but the difficult part is to prove the effects of chemicals,” Gabrielsen says as he closes in on the bearded seal deep in the ice jam. “It is my job to show these connections.”

Dutch biologist Maarten Loonen and an assistant play Mother Goose, caring for two-day-old goslings. Captured as hatchlings, the barnacle geese follow Loonen’s team everywhere, allowing him to sample blood all summer in an effort to better understand the threats to Arctic species.

Perched on an ice floe, the seal glances at us, its sleek, golden fur shimmering in the sun. “This is a young one,” Gabrielsen murmurs, “just born this spring.”

As we drift closer, the seal slips into the still waters and then resurfaces to study us with curious, mournful eyes. Sensing danger, the animal dives deep and vanishes, leaving us alone to contemplate the shattered Arctic ice.

Randall Hyman has spent the past 30 years covering global environmental issues, from the Arctic to the tropics.