



CLIMATE REFUGEES

COLLECTIF ARGOS / Introductions by Robert Reeves and Ivan Jouzel

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UNITED STATES

Alaska, the Kigiqtaamiut in jeopardy

Since our arrival three days ago, nothing has really changed along the shore. Under the effect of heavy snowfall, the waves look starched, weighed down as they are with thick grey slush. The sea is oily with melted snow that refuses to harden. This situation, however, should have rapidly changed three weeks ago. In the span of a few days, the snow should have turned into a thick layer of ice, flattening, immobilizing and cooling the sea until it became pack ice – but it is now late October, and this has yet to happen.

In Shishmaref, all eyes, full of impatience, are turned to the sea. Autumn seems to drag on forever, and a vague sense of unease has taken hold. Unseasonably high temperatures prolong this unsettled, in-between period, which is susceptible to violent storms that could break off whole chunks of shoreline without warning, and as long as there is no pack ice encircling the island, protecting it like a cocoon, the risk remains high. For the Inupiaq of Shishmaref, this wait – longer and more worrying every year – stirs up a nightmare that many others have already seen come true: a huge wave swallowing the whole village all at once.

It's now early November – and still no pack ice. Fierce gusts of wind threaten to pummel the village at any moment.

"When I saw the semaphore station plunge suddenly into the sea, I knew my house was going to be next. I had this strange feeling; I felt panicky and calm at the same time. We had to act fast. We had no time to waste because of the wind and waves. Within a few minutes, a human chain formed to help me clear out my house despite the cold and the gusty wind. People really support each other in Shishmaref. They think nothing of helping out because they know we're all facing the same fate. It only took an hour to find a safe place for most of my belongings. Meanwhile, the sea had swallowed up the last 6 feet (2 metres) of land separating it from the house, and below, the waves were already hollowing out the permafrost..."

On that morning in mid-October, Joe Braach had been working calmly at the village school, where he's the principal. The weather report called for moderate winds on the Seward Peninsula, but in recent years the weather in Alaska had changed so much that storms no longer forewarn of their approach. The storm suddenly struck Shishmaref in the middle of the afternoon. In only five hours, it devoured a 20-foot-wide (6-metre) strip of coastline, thus brutally shrinking the little island of Sarichef – 3 miles long by 1,300 feet wide (5 kilometres by 400 metres) – on which the Shishmaref community has been living for centuries.

Despite his natural composure, reinforced by the physique of a master mariner for whom the sea holds no secrets, the 50-something Joe acknowledges that he had a narrow escape. The storm vanished as fast as it had roared in, and his house was spared, but it now lives on borrowed time perched 3 metres above the Chukchi Sea, standing directly over the little beach on what remains of Shishmaref's small sand bluff. Three weeks have come and gone, but still no ice. *"Long live the pack ice,"* murmurs Joe, gazing absently out to sea.

Alaska is getting warmer at an ever-quickenening rate, with one of the fastest-rising temperatures in the world. The Shishmaref Inupiaq say they can now hunt seal by boat in early December. At the same time, storms have increased in frequency and strength – another known effect of global warming. In addition, Shishmaref's permafrost (permanently frozen Arctic ground) is thawing and no longer has its usual rock-like strength; it thus cannot withstand the battering of waves and wind during storms. Instead, large chunks of permafrosted land break off and fall into the sea. Erosion is spreading as well: Joe remembers that when he moved to the island in 1987, several dozen metres of shoreline separated him from the sea when he looked out his window, and he could see a semaphore station, the school's basketball court and sand dunes; all of these are now gone.

Over the past 20 years, four levees were built in an attempt to contain erosion, but the effort failed; the levees quickly sank into the fine sand. Traces of the levees can be found here and there entangled among the piles of old, broken-down equipment that make Shishmaref's beach highly unattractive. In desperation, islanders threw anything on the beach that they no longer needed – snowmobiles, quads, and obsolete construction equipment – to stem the assault of the voracious waves, like making sacrifices to a demon god.

Early that morning, someone came to warn Mina Weyiouanna. Her house ended up falling: it had long perched precariously on the bluff above the sea, and that night it toppled over the edge. In another few days, it would undoubtedly be torn apart by the next storm and washed away by the sea. Mina shyly walks through the village with an impassive look on her face. She brings a photograph of her grandparents so she can pose with them, but she wants to do it quickly – she doesn't want to attract a crowd of people. Mina is modest, and knows how painful it will be to see her half-collapsed house. *"I have so many memories,"* she says.

Mina was born 47 years ago in one of the last traditional huts made of canvas and whalebone. Adopted by her grandparents at age one, she grew up with them in the house that fell on the beach that night. *"I can still see myself playing dominoes with my grandfather,"* she says with dignity. *"At the time, the house was still over 300 feet (100 metres) from the shore."* In 1982, after the birth of her first daughter, Mina moved to a new house right next to her grandparents; 20 years later, her house would be one of 18 that the Shishmaref community moved to the other end of the village, setting in motion the first retreat from the advancing waves.

A naturally cheerful person, Mina is quickly overcome with emotion when she talks about the move, recalling the house suspended in the air by a crane specially shipped over by barge from the city of Nome. Placed on giant skis, the house was pulled far from the threatening waves. *"It was so sad I could barely watch. It was almost night, and it had to be done quickly. When we returned to our house, now far from the shore, everything was upside down...I just wanted to cry."* What's more, Mina is having trouble getting used to her new neighbourhood, which is located on an old runway that had become too short due to erosion. *"Over there, we're far from the village centre and relationships in the community have drastically changed."* Furthermore, Mina had to leave behind her grandparents' house where she grew up, long abandoned to the ocean's inexorable ad-

vance – until the night when the shore, eaten away by the waves, yielded under its weight.

Wearing his usual yellow earmuffs to protect him from the biting cold, Jimmy Nayopuk has come down to the beach, which is covered with still-soft snow. With a melancholy look on his face, he points vaguely at the sea and the nearby shore. *“That’s where it was,”* he says. *“My house was 100 feet (30 metres) from here, maybe 150. During the storm of 2000, we couldn’t do anything about my house. It broke apart when it fell, and I lost all my belongings. Since then, I’ve been living with my mother – I can’t afford to build another house.”* Johnny and Roberta Weyiouanna join us. They are also trying to describe Shishmaref’s old western neighbourhood, which no longer exists. They were luckier than Jimmy; their house had been moved to the other side of the village. Like Mina, Roberta is having trouble adjusting: *“I miss the sound of the sea; I don’t like the silence at night. But the island is shrinking. Other houses have since been moved and more will be, too. We have no choice.”*

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No choice. As the island shrinks at an ever-increasing pace, the 600 inhabitants of Shishmaref have no other solution than to retreat. In 2001, most of them voted to relocate the village by 2015, their last chance before Sarichef becomes uninhabitable, according to the geologists, meteorologists and other experts who have flocked to the aid of these climate refugees living on borrowed time. Relocate, yes – but to where?

The future of the Shishmaref community has yet to be determined, but two possible solutions have emerged. The first involves moving it to small towns around Nome and Kotzebue, 200 miles to the south and east, respectively, to take advantage of their urban infrastructure. With an estimated cost of \$100 million (€74 million), this is the less expensive alternative and the one favoured by the state of Alaska and federal funding agencies. The second alternative, estimated to cost \$200 million, would involve relocating the village to the mainland only 12 miles from Sarichef. The village would be fully recreated in an uninhabited area called Tin Creek that would be safe from erosion. *“The state will never pay the extra cost,”* says Jonathon Weyiouanna, Johnny’s father-in-law. *“We’ll have to find other funding. If we fail, we’ll disappear. Our special culture, our community traditions like sharing and respect for our ancestors, our subsistence economy – everything*

that makes us a unique community will perish in a city like Nome, which is foreign to Inupiaq culture." The community's struggle can be summed up in these words: relocate to Tin Creek or disappear.

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INDIAN OCEAN

Maldives, an archipelago in peril

Looking down at it from the plane, the first thing we feel is amazement. It's a sun-drenched world of blues and greens, a handful of emeralds strewn from the heavens into a halo shape on an ocean the colour of the night sky. Lagoons jut up out of the waves like so many pearls scattered in vast atolls, the giant petals of a rare, fragile, vulnerable aquatic flower. Vulnerable – that's the word that best expresses the indefinable feeling of uneasiness that follows our amazement. Looking down on the Maldives, we realize how fragile these islands really are. A puff of wind, a wave, and this emerald necklace that appears to be floating precariously on the water might just sink irretrievably into the depths of the Indian Ocean.

The submarine topography around the Maldives is extraordinary. Nothing on dry land comes close, except perhaps the comparatively Lilliputian Monument Valley in the United States. A dozen underwater mountains rise up steeply from the flat seafloor 4,000 metres below. Their climb towards the air is abruptly interrupted 100 metres below the surface, where they form immense plateaus that are sometimes dozens of kilometres wide. These are the Maldivian Atolls. For millions of years these plateaus, in particular their dizzying edges, have been home to colonies of coral. Like cones of sugar, they cover the mountain with spiny vertical peaks up to the water's surface, where the sea creates the turquoise colour characteristic of coral reefs. These are the lagoons. The majority of these plateaus are

submerged, but some rise up 1-2 metres out of the water and are covered with white sand and coconut trees. These are the Maldivé Islands. There are some 1,200 of them – totalling just 300 square kilometres – but only 200 of the islands are inhabited.

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On one of them, the sand has been replaced by a blanket of concrete, and a forest of high-rises has ousted the coconut trees. This is Malé, the capital, where one-third of the total Maldivian population of 360,000 squeezes together onto 2 square kilometres, making it one of the most densely populated capitals on earth. It's a far cry from the idyllic images of postcards. Over the past 30 years, Malé has come to resemble a mini-Manhattan perched on a fragile coral peak. We ask some inhabitants a few cautious questions about the effects global warming might have on the future of the Maldives. It's a bit of a taboo subject in Malé, but they soon admit to feeling some trepidation. They wonder, for example, whether the coral mountain peak could collapse under the weight of the city some day. When we visit the Marine Research Centre, members of its staff explain that, during the last ice age, the sea level was several dozen metres lower than it is today. Over the centuries, the waves carved a deep hollow into the coral at that level. It's as if Malé were built atop a needle propped up on a base of clay – the coral is just as fragile. It's hard to know whether these are mere imaginings or something closer to the truth. They say that when the seafloor was sounded prior to construction of the wall around Malé, the Japanese divers discovered a very strange crevasse at the foot of the steep slope beneath the city. Long before it's ever swallowed up by rising waters, Maldivians fear, Malé may very well collapse into them – a kind of Apocalypse before the Flood.

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Like everyone in Malé, Mohammed Ali, director of the Maldives Environmental Research Centre, has already heard talk of this danger. Malé is a sinking ship, people say, overloaded, undone by its own weight. These are the beliefs of the common folk, perhaps, but not totally unfounded, Ali tells us, adding that, until more is learned, it might be a good idea to prohibit construction of new buildings on the few free spaces remaining in the city. As a scientist, however, he knows that there are more urgent matters to attend to. He shows

us into a huge conference room, where a giant photo of the Maldives covers an entire wall. That sense of extreme fragility returns.

Ali spends two hours with us, explaining the message he's been spreading since 1991, when he participated in the drafting of the first IPCC report. The waters are rising, and fast, he says. This is caused in part by glacial melt, but the warming water's expansion plays an even larger role. Ali has observed that the sea level rises by an average of 5 millimetres per year, *"which would mean 50 centimetres by the end of the century if the warming were to continue at the same pace,"* he points out. *"As we know, however, the warming is accelerating, so we must expect a greater rise in sea level."*

And it gets worse. Before the Maldives are even flooded, Ali tells us, they may be eaten away by erosion, which is growing in intensity. *"Erosion is completely natural in the Maldives. It's caused by marine currents scraping the islands, but it has always been compensated for by an accretion of similar scale. When a beach disappears from one side of an island, it reappears on the other side, and vice-versa when the current changes direction with the season. We've seen that this natural balance is now broken, and that erosion wins out over accretion. The ill health of the coral is at fault."* He makes some quick sketches to show us how each island is encircled by a coral lagoon that functions as a breakwater to protect the beaches. *"It all depends on the coral,"* he says again. *"It's a living organism that's very sensitive to fluctuations in water temperature. It more or less succeeded in adapting to the planet's previous climate changes, but that's because they took place over several millennia. The current global warming is happening much more rapidly. There's no guarantee that the coral will survive. And without coral, the Maldives will quickly crumble into the sea."*

And so coral is on the front line in the fight against the slow but infinite assault of the waves, and it recently had the opportunity to alert people to its fragile health. In 1998, the climatic phenomenon El Niño – believed to be intensified by global warming – had disastrous consequences for the Maldives. The water temperature is usually very stable at about 28° C, but that year it climbed to 31° C and stayed there for six weeks. This extra heat was enough to cause an unprecedented amount of coral bleaching, which means that the coral has died. Pilots of seaplanes linking the islands were the first to notice this disaster, in which two-thirds of the coral reef was damaged. And although the coral is quickly returning in some areas, it will take two or three more decades before the damage done by El Niño is repai-

red – and that's only if no more damage is done to the coral in the meantime. In other words, the water temperature must remain stable.

In Ali's opinion, El Niño showed Maldivians just how dependent they are on the coral reef. They better understood the reasons why, in the 1980s, the government had banned the longstanding practice of coral mining. Bricks cut right out of the coral reef were once used to construct buildings, but this could not continue. If the coral reef were to disappear, the whole country would have to be crossed off the map, and even if that didn't happen, it's certain that the country's entire economy – dependent as it is on coral – would founder.